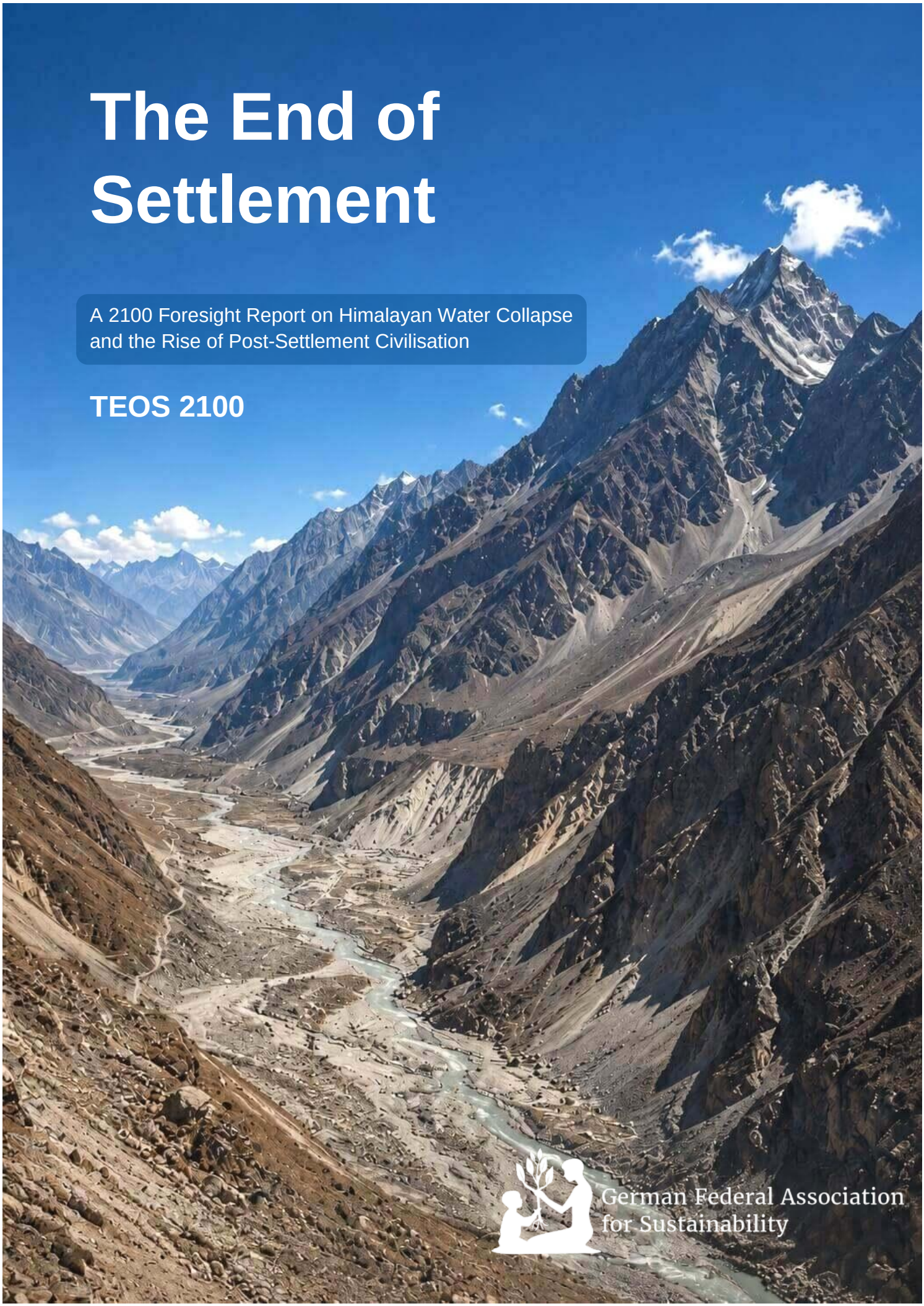
The End of Settlement

A 2100 Foresight Report on Himalayan Water Collapse and the Rise of Post-Settlement Civilisation

TEOS 2100



German Federal Association for Sustainability

Imprint

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Foreword

For much of human history, people have moved in response to changing environmental conditions, economic opportunities and political circumstances. Yet many institutions that shape modern societies are organised around the expectation that people maintain a relatively stable place of residence. Public services, infrastructure, property rights and political representation are closely connected to territory and established administrative boundaries.

What happens when this expectation can no longer be taken for granted?

The End of Settlement explores this question through a long-term foresight study centred on the Hindu Kush Himalayan region. Its glaciers, snow-covered mountains and river systems contribute to the water resources on which extensive parts of Asia depend. Changes in glacier mass, seasonal runoff and the reliability of water supplies may have far-reaching consequences for agriculture, energy production, livelihoods and human settlements.

These environmental changes are already underway, although their consequences differ considerably between regions. How they will affect societies over the coming decades will also depend on economic conditions, population developments, infrastructure, political decisions and the capacity of communities to adapt.

The year 2100 provides a horizon for considering these developments across several generations. It allows us to examine a future in which permanent residence may become a less reliable foundation for the economic and social lives of substantial populations. Some people may relocate permanently. Others may move seasonally, maintain livelihoods across several locations or develop new relationships with the communities in which they live and work.

Many will continue to remain in established settlements. Their future will depend partly on whether essential services, livelihoods and environmental conditions can be maintained.

We regard the emergence of post-settlement forms of social organisation as a plausible development that deserves serious consideration. The environmental and societal pressures underlying this possibility are already observable. Their long-term consequences, however, remain uncertain. We cannot determine whether a post-settlement civilisation will emerge or what form it might take.

We can examine the circumstances under which existing settlement arrangements may come under pressure and the choices that could influence their future.

The title *The End of Settlement* refers to this possibility. It does not suggest that cities, villages, territorial states or permanent homes will disappear. Rather, it challenges the assumption that stable residence can remain the principal foundation of social organisation under all future conditions.

If people increasingly maintain their lives across several locations, institutions may need to reconsider how rights, public services and political participation are organised.

TEOS 2100 is a foresight study, not a prediction. It draws on existing scientific research, demographic projections and institutional experience to examine possible developments and their consequences. Throughout the report, we distinguish between observed changes, evidence-informed assumptions and constructed futures.

Environmental pressures may influence human mobility, but they do not determine a single political or social outcome. The decisions of governments, communities, businesses and individuals will influence whether changing settlement conditions lead to greater insecurity or create opportunities for adaptation.

Four scenarios explore these possibilities: Fortress Earth, Negotiated Mobility, Networked Nomads and Planetary Transition. They examine contrasting ways in which societies might organise access to resources, mobility, public services and political authority. None is presented as an inevitable future or a comprehensive description of what the world will become.

To make their implications more tangible, the report also introduces fictional lives set in the year 2100. These stories examine how people might experience the institutional arrangements described in the scenarios. Their characters encounter questions concerning employment, family responsibilities, access to water, political membership and the ability to remain in places they consider home.

The narratives do not provide evidence of future events. They allow us to consider how different forms of social organisation could affect individual lives.

Our approach reflects an understanding of sustainability as an ongoing process of societal development. We consider the capacity of people and institutions to respond to change, negotiate competing interests and act within ecological limits.

This perspective places human agency and participation at the centre of the analysis.

The consequences of environmental change cannot be understood solely through the physical movement of populations. People may lose access to rights and services when they relocate. Communities receiving newcomers may struggle to accommodate additional needs. Those who remain in environmentally exposed areas may face increasing insecurity without possessing the means or desire to leave.

These circumstances raise questions about responsibility and belonging.

Where should people be able to participate in political decisions when their citizenship, residence and livelihoods are associated with different places? How can institutions recognise the interests of established residents and newcomers? What responsibilities do societies have towards people whose ability to move is restricted by economic circumstances, health or family commitments?

Such questions concern the organisation of society as much as the management of migration.

The report also considers longer-term implications for human development. It examines how technologies, resource constraints and institutional arrangements might shape the capacity

to sustain human life across different environments, including the possibility of activities beyond Earth.

These considerations extend the perspective of the study. They do not suggest that space settlement offers an alternative to addressing environmental problems on this planet.

TEOS 2100 was developed by the German Federal Association for Sustainability with contributions from an international student research team. Their research and different disciplinary perspectives informed the analysis and the exploration of possible futures presented here. We also thank Dr. rer. nat. Cosmas Kombat Lambini for his scientific review and critical guidance.

Our intention is to contribute to a discussion that extends beyond the immediate consequences of climate change. The future of settlement concerns the places people will be able to inhabit, but it also concerns the relationships and institutions through which they organise their lives.

People may continue living in familiar communities, establish homes elsewhere or maintain connections across several locations. Their circumstances will differ, as will the choices available to them.

What should remain open is the possibility of participating in society, maintaining recognised rights and sustaining relationships that give people a sense of belonging. These are questions worth examining while decisions about the future of settlement can still be made.

About the Publisher

German Federal Association for Sustainability (Germany)

The German Federal Association for Sustainability (Bundesvereinigung Nachhaltigkeit e.V., BVNG) is an independent, non-profit civil society organisation based in Berlin, Germany. Founded in 2013, it brings together perspectives from civil society, academia, education, business and public institutions to examine how societies can develop within ecological limits while maintaining social participation, cultural diversity and long-term responsibility.

BVNG understands sustainable development as an ongoing process rather than a fixed condition to be achieved. This understanding goes beyond the conventional distinction between environmental, social and economic sustainability. It places greater emphasis on how societies respond to change, negotiate competing interests and develop the capacity to act under uncertain conditions. Participation, cultural embeddedness and balance orientation form the foundation of this approach.

The organisation works at the intersection of sustainability policy, education, research, innovation and practical implementation. Its activities include developing educational approaches, contributing to policy discussions, supporting interdisciplinary cooperation and participating in European and international projects. BVNG seeks to connect scientific knowledge with institutional decision-making and practical experience, recognising that complex societal developments rarely follow the boundaries of individual disciplines or policy sectors.

Its current work focuses on three strategic areas: nature-based resilience and carbon systems; future skills and education for transformation; and material and system innovation within planetary boundaries. These fields address questions of resource availability, ecological adaptation, economic resilience and the capacity of individuals and institutions to respond to structural change.

Education for sustainable development and vocational education have been longstanding areas of BVNG's work. Through educational initiatives, international cooperation and applied research, the organisation examines how people acquire the knowledge, judgement and capacity to act in changing professional and social environments. Its work on circular economy, resource systems and nature-based approaches extends this perspective to economic activities, technologies and the relationship between human development and natural systems.

A recurring concern across these activities is resilience. BVNG examines how institutions, communities and economic systems can maintain essential functions when established conditions change. This requires attention to the interaction between ecological processes, technological developments, economic dependencies and political decisions. It also raises questions about whose interests are represented, how resources are distributed and whether existing institutions remain capable of responding to emerging needs.

TEOS 2100 extends this work into long-term strategic foresight. The report examines a possible future in which climate-related changes to Himalayan water systems place

increasing pressure on established forms of settlement and social organisation. Its central concern is how societies might respond when mobility, resource insecurity and changing environmental conditions challenge institutions built around permanent residence and territorial stability.

For BVNG, this question follows from its understanding of sustainability as a societal development process. The ability to adapt cannot be considered separately from access to rights, public services, education, economic opportunities and political participation. TEOS 2100 therefore approaches the consequences of environmental change through the interaction of ecological conditions and human institutions.

The report reflects BVNG's interest in connecting present decisions with long-term societal consequences. It is intended as a contribution to research, policy dialogue and public discussion about the conditions under which human societies may remain viable in a changing world.

Website: https://nachhaltigkeit.bvng.org/en/

Executive Summary

The End of Settlement: A 2100 Foresight Report on Himalayan Water Collapse and the Rise of Post-Settlement Civilisation

Modern societies are largely organised around the expectation that people maintain relatively stable places of residence. States exercise authority within defined territories. Public services, infrastructure, legal rights and political representation are closely connected to established administrative boundaries.

Climate change raises questions about the long-term reliability of the environmental conditions supporting these arrangements.

TEOS 2100 examines a possible future in which environmental pressures contribute to significant changes in settlement patterns and human mobility. Its geographical starting point is the Hindu Kush Himalayan region, where changes in glaciers, snow cover and seasonal water availability could affect major river systems across Asia.

These changes may influence agriculture, energy production, economic livelihoods and the capacity of settlements to maintain essential services. The consequences could extend far beyond the mountain regions themselves. The countries associated with the river systems examined in this report could have a combined population of approximately 3.0 to 3.3 billion people by 2100, according to the demographic assumptions used in the analysis.

This figure illustrates the geographical and demographic scale of the countries concerned. It does not represent the number of people directly exposed to Himalayan water insecurity or expected to migrate. The environmental pressures underlying the report are already observable. Glaciers are retreating, mountain hazards are affecting settlements and infrastructure, and changes in water availability are creating difficulties for communities and economic activities.

Their consequences vary considerably between river basins and locations. The interaction between environmental change, economic dependence, demographic developments and political decisions creates risks extending beyond climate science. TEOS 2100 examines how these processes could affect the relationship between people, the places they inhabit and the institutions on which their lives depend.

From water insecurity to changing settlement patterns

Himalayan water systems contribute to agriculture, hydropower, urban infrastructure and regional economic activity. Changes in seasonal river flows, water reliability and exposure to extreme events may influence food production, employment, household incomes and public services. These developments do not automatically lead to migration.

Communities may respond through improved water management, infrastructure adaptation, changes in agricultural practices and the diversification of livelihoods. Some households may maintain their established residence while earning income elsewhere. Others may relocate temporarily or permanently. People with limited financial resources, care responsibilities or

restricted legal opportunities may be unable to leave even where living conditions deteriorate.

Mobility and immobility must therefore be considered together. The ability to move is unequally distributed, and migration cannot be assumed to provide protection in every circumstance. For TEOS 2100, the central institutional challenge emerges when changing patterns of residence make it increasingly difficult to maintain access to rights, services and political participation.

Education, healthcare, employment and social protection are often organised around fixed administrative boundaries. People living across several jurisdictions may encounter interruptions in legal recognition or access to essential services. The report uses the concept of a *Post-Settlement Civilisation* to examine the possible transformation of these relationships.

The term does not imply that cities, villages, territorial states or permanent homes will disappear. It describes a possible condition in which stable residence becomes less sufficient as the principal organising assumption for social institutions. Under these circumstances, societies may need arrangements capable of supporting people across changing locations while maintaining viable conditions for those who remain.

Four possible futures

TEOS 2100 develops four scenarios that examine different institutional responses to environmental insecurity and human mobility. They are constructed futures rather than predictions. Each explores how political authority, resource management, economic arrangements and technological development could influence social life under changing conditions.

Fortress Earth describes a future in which states increasingly respond to environmental insecurity through territorial protection, restrictive border policies and competition over resources. Access to secure settlements and essential services becomes unevenly distributed. Public authorities may maintain advanced infrastructure within protected areas while populations outside them experience greater insecurity. The scenario examines the social and political consequences of prioritising territorial control over broader institutional cooperation.

Negotiated Mobility explores a future in which governments establish more extensive agreements concerning population movement, access to services and shared resources. Citizenship and territorial sovereignty remain significant, but regional cooperation supports recognised pathways for employment, relocation and the coordination of public responsibilities. The effectiveness of these arrangements depends on political negotiation, adequate financing and the ability of national commitments to be implemented within receiving communities.

Networked Nomads examines a technologically connected society in which employment, services and economic relationships increasingly extend across locations. Digital platforms and distributed infrastructure enable some people to organise their lives without relying on permanent residence in one place. These opportunities are unevenly distributed.

Dependence on commercial systems can create new forms of insecurity where employment, access to services and essential infrastructure are controlled through private organisations. Technological connectivity does not necessarily produce political inclusion or reliable social protection.

Planetary Transition explores a more coordinated transformation in the relationship between social organisation, resource use and ecological limits. Communities and institutions develop arrangements for managing shared resources and adapting livelihoods under changing environmental conditions. Cooperation and collective decision-making play a greater role, while resource allocation remains constrained by physical availability and established interests. The scenario also examines tensions concerning membership, political participation and the legitimate claims of newcomers and established residents. It does not assume that ecological coordination removes conflict. Together, the four scenarios demonstrate that environmental pressures do not determine a uniform political or social outcome. Similar challenges can produce different consequences depending on how institutions allocate authority, resources and rights.

Human experiences in 2100

To examine what these futures might mean for individual lives, TEOS 2100 presents fictional accounts of people living in the year 2100. The stories take the institutional arrangements of their respective scenarios as an established reality. They describe people seeking employment, maintaining family relationships, accessing water and public services, and negotiating their place within changing communities.

- Under *Fortress Earth*, established systems of protection and access create difficult choices for people living within and beyond secure territories.
- In *Negotiated Mobility*, relocation agreements provide recognised pathways while households and receiving municipalities confront the practical consequences of movement.
- The *Networked Nomads* stories examine the opportunities and dependencies associated with mobile employment and digital systems, including the difficulties faced by people responsible for dependent family members.
- *Planetary Transition* follows communities managing shared resources and the claims of individuals whose contribution to collective life is not automatically recognised through established membership rules.

These narratives reveal how institutional arrangements may influence everyday experiences. They also show that mobility cannot be understood solely through transport, employment or access to infrastructure. The ability to remain, maintain relationships and participate in decisions may be equally significant. The stories are not evidence of future developments. Their purpose is to explore the human consequences of the scenarios from within the conditions they describe.

Institutional adaptation and human agency

The central question raised by TEOS 2100 extends beyond migration management. How can societies maintain rights, essential services and political participation when people

increasingly organise their lives across different locations? The answer depends on institutions as well as technology.

Educational records and professional qualifications may need to remain recognised across jurisdictions. Healthcare and social protection systems may require greater continuity as residence and employment change. Municipalities and receiving communities need sufficient resources to accommodate population changes without reducing the quality of services available to established residents. Water, energy and food infrastructure may benefit from more modular and distributed arrangements.

However, such systems remain dependent on materials, maintenance, technical knowledge and wider networks of production and supply. Their availability alone does not establish equitable access.

Digital identity and communication technologies may improve administrative coordination, but they can also introduce risks of surveillance, exclusion and dependence on commercial platforms. Political participation presents a related challenge. Citizenship, residence and affectedness do not always coincide. People may be subject to decisions made by authorities in whose political processes they have limited opportunities to participate.

Institutions may therefore need arrangements that recognise continuing political relationships across locations while respecting existing legal frameworks and territorial sovereignty. The report treats human agency as central to these developments. Environmental conditions create constraints, but they do not determine how societies distribute resources, organise rights or respond to competing claims. Institutional legitimacy depends partly on whether affected people can participate in these decisions and obtain remedies when their rights are restricted.

Planetary boundaries and longer-term human development

The transformation of settlement patterns does not remove ecological limits. Mobility requires energy, materials and infrastructure. New residential areas place demands on land and water. Decentralised technologies may improve resource efficiency while creating additional production and maintenance requirements.

The planetary boundaries framework provides a wider perspective on these pressures. The *Planetary Health Check 2026* concluded that seven of the nine assessed planetary boundaries had been transgressed, indicating substantial pressures on processes supporting the stability of the Earth system. These findings reinforce the need to evaluate future adaptation and settlement development through their broader environmental consequences.

Changes in regional climate may alter the suitability of particular areas for agriculture or habitation. However, shifts in precipitation or temperature do not automatically create new settlement opportunities. Their consequences depend on ecological conditions, infrastructure and the rights of people already using the land.

The report also considers the possible longer-term development of human activities beyond Earth. Current orbital and lunar programmes provide experience with technical systems

designed to sustain human life under restrictive conditions. Future facilities may raise further questions concerning resource management, employment, jurisdiction and political participation. Yet sustained habitation beyond Earth remains subject to substantial technical, economic and institutional uncertainties.

TEOS 2100 does not present space settlement as an alternative to addressing environmental pressures on Earth. The relevance of this longer-term perspective lies in the relationship between technological capability and the institutions required to maintain human life across different environments. A technically functioning habitat is not automatically a viable society. The same distinction is relevant to terrestrial mobility and adaptation.

Strategic implications

TEOS 2100 identifies several areas in which institutions can prepare for changing environmental and settlement conditions.

- Public planning should consider alternative population developments rather than assume that demand for housing, infrastructure and services will remain geographically stable.
- Governments can examine barriers that interrupt access to recognised rights and entitlements when people move between jurisdictions.
- Regional cooperation may strengthen the management of shared water resources and support agreements concerning employment, relocation and public services.
- Infrastructure planning should assess where modular or decentralised systems could improve continuity during disruption.
- Education and professional development can support the ability of people and institutions to respond to changing resource conditions and working environments.
- Technology procurement should consider repairability, accessibility, privacy and accountability alongside technical performance.

These measures differ in their time horizons and institutional requirements. Some address existing weaknesses and could be valuable under several future scenarios. Others involve more extensive legal or political arrangements whose necessity and feasibility will depend on future developments.

The interests of people who remain in established communities must receive the same consideration as those who relocate. This includes households with limited mobility options and communities whose continued viability depends on investment in adaptation. Policies must also address the needs of receiving populations and the distribution of responsibilities between different levels of government.

Conflict resolution and political participation are central to these arrangements. Environmental pressures may create competing claims on land, water and public resources. Institutions require procedures through which affected people can participate and disagreements can be considered.

The capacity to maintain social continuity under changing conditions cannot be reduced to administrative efficiency. It also depends on recognition, rights and the relationships through which people experience belonging.

The central question

The End of Settlement does not predict that humanity will abandon permanent places of residence by 2100.

It examines what may happen when the environmental, economic and institutional conditions supporting settled life become less reliable for some populations. The extent and direction of such changes remain uncertain. Some settlements may adapt successfully. Others may experience declining viability or require substantial transformation. Households may respond through permanent relocation, temporary movement or livelihoods maintained across several locations.

The institutional consequences will depend on the choices societies make. TEOS 2100 suggests that the long-term future of settlement cannot be understood solely through environmental change or the movement of populations. It must also be examined through the institutions governing access to resources, public services and political participation.

A society may possess the capacity to move people and provide infrastructure while failing to protect their recognised rights. It may maintain secure settlements for some populations while excluding others. It may develop sophisticated technologies without establishing accountable arrangements for their use.

The challenge is therefore to preserve the conditions for secure and meaningful lives as relationships between people and places change. This includes the freedom to move, the ability to remain and the opportunity to participate in the communities on which people depend.

The future of settlement remains open.

What TEOS 2100 asks is whether the institutions governing human life can adapt as the environmental and social circumstances supporting it continue to change.

Key Findings

1. Himalayan water insecurity represents a systemic risk extending far beyond the mountain region.

Evidence-based finding

Climate change is altering glaciers, snow cover and seasonal water availability across the Hindu Kush Himalayan region. These developments affect river systems supporting agriculture, hydropower, urban infrastructure and livelihoods across large parts of Asia. Their consequences vary between river basins and communities. Glacier retreat does not necessarily lead to a continuous decline in river discharge. Changes in precipitation, seasonal runoff and the frequency of damaging events can create different forms of water insecurity.

The interaction between environmental change, economic dependencies and political decisions may produce consequences extending beyond the areas directly exposed to mountain hazards. TEOS 2100 therefore examines Himalayan water insecurity as a potential source of interconnected environmental, economic and institutional pressures rather than as a single process of freshwater depletion.

2. Climate-related mobility may develop through different pathways rather than a single wave of displacement.

Evidence-based finding and scenario-based assumption

Environmental change rarely acts as an isolated cause of migration. Its consequences interact with employment opportunities, household resources, social networks, legal conditions and the capacity of communities to adapt. Existing research indicates that much climate-related movement occurs within national borders or towards neighbouring regions. It also demonstrates that environmental pressures can restrict mobility when affected households lack the resources needed to relocate.

TEOS 2100 examines how prolonged water insecurity could influence these patterns over several generations.Possible responses include seasonal and circular migration, permanent relocation, livelihoods maintained across several locations and continued residence in environmentally exposed communities. The report does not estimate the number of people who may migrate by 2100. It treats movement and immobility as different possible responses to changing environmental and social conditions.

3. The viability of permanent settlement depends on institutional and economic conditions as well as environmental change.

Evidence-based finding and scenario-based assumption

Environmental hazards do not necessarily make a settlement permanently uninhabitable. Its continued viability also depends on infrastructure, economic opportunities, access to essential services and the capacity of residents and public institutions to adapt. A community

may remain physically accessible while becoming increasingly difficult to sustain because water supplies, employment or public services have become unreliable. Conversely, investments in adaptation and changes in economic activity may allow communities to remain in locations experiencing substantial environmental pressure.

TEOS 2100 explores the possibility that repeated disruptions could weaken the role of permanent residence as the principal basis of social organisation. This does not imply the disappearance of cities, villages or territorial states. The concept of a Post-Settlement Civilisation describes a possible development in which institutions must increasingly accommodate lives organised across several locations.

4. Water insecurity may intensify geopolitical tensions, but political decisions will shape whether competition develops into conflict.

Evidence-based finding and scenario-based assumption

Major river systems associated with the Hindu Kush Himalayan region extend across national borders, connecting upstream and downstream populations through shared water resources and infrastructure. Existing disputes involving the Indus and Brahmaputra river systems demonstrate the political sensitivity of water allocation and large-scale infrastructure development. Changes in seasonal flows, extreme events and competing demands may increase pressure on these relationships.

However, environmental change does not automatically produce armed conflict. The consequences depend on political decisions, the availability of reliable information and the effectiveness of institutions managing shared resources. Cooperation on monitoring, water allocation, infrastructure and dispute resolution may reduce uncertainty and support adaptation. TEOS 2100 therefore treats geopolitical outcomes as contingent on governance rather than as inevitable consequences of declining water security.

5. Increasing mobility may reveal a growing mismatch between people's lives and institutions organised around permanent residence.

Scenario-based assumption and institutional finding

Many public institutions determine responsibilities and entitlements through residence, nationality and territorial jurisdiction. These arrangements provide continuity for populations living within relatively stable administrative boundaries. However, people who repeatedly change location or maintain livelihoods across several jurisdictions may encounter interruptions in education, healthcare, employment rights and social protection.

The difficulty extends to political participation. Citizenship, residence and affectedness do not always coincide. Individuals may retain electoral rights in one country while being subject to decisions made by authorities elsewhere. TEOS 2100 identifies this potential separation between individual lives and established institutional responsibilities as a central feature of post-settlement futures. The challenge is not mobility itself, but the ability of institutions to maintain recognised rights, public services and political accountability when people and responsibilities extend across different places.

6. Mobility can support adaptation, but the freedom to remain is equally relevant to human security.

Evidence-based finding and strategic implication

Migration can provide access to employment, education, safer living conditions and opportunities to diversify household income. Yet the ability to move safely is unevenly distributed. People with limited financial resources, restricted legal status, disabilities or care responsibilities may face obstacles to relocation. Cultural attachments and established livelihoods may also influence decisions to remain. A policy that treats movement as the preferred response to environmental pressure risks overlooking these circumstances.

Equally, remaining in a hazardous location may expose people to serious risks where adaptation is insufficient or unavailable. TEOS 2100 therefore considers meaningful choice central to the evaluation of future mobility arrangements. Institutions should support continued habitation where it remains viable and provide safe alternatives where relocation becomes necessary. The right to move and the ability to remain should be understood as connected elements of human security rather than competing objectives.

7. Different political responses to environmental change could produce fundamentally different post-settlement futures.

Scenario-based finding

The four scenarios developed in TEOS 2100 demonstrate how environmental pressures and increasing mobility could interact with different arrangements of political authority, economic activity and resource governance.

Fortress Earth explores territorial exclusion, restrictive borders and unequal access to protected infrastructure.

Negotiated Mobility examines institutional cooperation, recognised movement pathways and the coordination of public responsibilities across national boundaries.

Networked Nomads considers technologically supported mobility alongside dependence on private platforms and uneven access to rights.

Planetary Transition explores coordinated adaptation, ecological responsibility and collective resource governance, including conflicts over membership and political participation.

None of these scenarios represents a prediction or an inevitable stage of development. They demonstrate that comparable environmental pressures may lead to different social outcomes depending on the institutions and political choices involved. The scenarios also show that technological capacity and economic flexibility do not automatically produce equitable or legitimate arrangements.

8. Portable rights and services may become essential, but institutional continuity requires more than technical interoperability.

Strategic implication

If mobility becomes a lasting condition for substantial parts of society, institutions may need to maintain access to recognised entitlements across changes in residence and employment. Educational records, professional qualifications, healthcare information, social security and legal identity are relevant to this continuity. Modular infrastructure and distributed service provision may also improve access to water, energy, education and healthcare under changing settlement conditions. However, the ability to transfer information or equipment does not establish corresponding legal rights.

A digital record cannot independently guarantee access to a service. A recognised qualification does not automatically provide permission to work in another jurisdiction. Institutional continuity therefore depends on agreements, clearly assigned responsibilities and accessible procedures for resolving disputes. Public accountability remains necessary where services are provided through private networks or digital platforms. For TEOS 2100, the portability of rights is a legal and political question as much as a technological one.

9. Political participation and social belonging are central to the viability of post-settlement societies.

Institutional finding and strategic implication

Societies can provide technically reliable infrastructure while leaving individuals with limited influence over decisions affecting their lives. This risk may become more significant where people maintain economic and social relationships across several jurisdictions. Existing institutions commonly distinguish between citizenship, residence and membership in local communities. These relationships influence access to political representation and shared resources. Increasing mobility may expose situations in which people contribute to a community without acquiring recognised opportunities to participate in its decisions.

TEOS 2100 examines these tensions through governance arrangements and fictional experiences of life in 2100. The analysis demonstrates why social belonging cannot be reduced to legal identity or physical residence. It develops through relationships, participation and shared responsibility. Institutions capable of accommodating mobility must therefore consider how established residents and newcomers can participate in decisions, maintain cultural relationships and negotiate competing claims. The ability to belong remains relevant whether people move, return or remain in one place.

10. Long-term human adaptation must operate within ecological limits and cannot be achieved through technological expansion alone.

Evidence-based finding and strategic implication

The planetary boundaries framework indicates that human activities are already placing substantial pressure on processes supporting the stability of the Earth system. The *Planetary Health Check 2026* concluded that seven of nine assessed planetary boundaries had been transgressed. These findings provide a wider environmental context for evaluating future settlement patterns and technological adaptation.

Mobility, infrastructure development and decentralised resource systems require energy, materials and access to natural resources. Their environmental consequences must be considered beyond individual locations. Technologies supporting resource efficiency, repairability and distributed services may improve adaptation, but they do not eliminate material constraints or determine how resources should be allocated.

The longer-term possibility of human habitation beyond Earth introduces additional technical and institutional questions. Space facilities would depend on carefully managed life-support systems and arrangements governing shared resources, employment and political authority. However, TEOS 2100 does not present space settlement as a solution to environmental pressures on Earth or as an inevitable continuation of terrestrial mobility.

The wider implication is that societies must develop the capacity to sustain human life under changing conditions while maintaining ecological responsibility, recognised rights and legitimate institutions. The future of settlement will depend partly on whether these capacities develop together. Human expansion, whether across changing environments on Earth or potentially beyond it, cannot substitute for the responsibility to maintain viable conditions for people and communities within the environments they already inhabit.

1. Introduction: Why Settlement Becomes a Question

1.1 The Problem

Modern societies are largely organised around permanent settlement. States exercise authority within defined territories, public institutions serve populations associated with particular locations, and economic systems depend on infrastructure developed for relatively stable patterns of residence.

This arrangement has shaped how people access education, healthcare, employment, housing, legal protection and political participation. Schools and hospitals serve geographically defined communities. Administrative systems assign responsibilities through addresses and jurisdictions. Property rights, taxation and social protection are closely connected to territorial institutions. Although people move throughout their lives, most public systems continue to assume that residence provides a relatively stable basis for organising society.

Permanent settlement has supported the development of complex institutions, economic specialisation and long-term infrastructure. It has also created dependencies that are less apparent under stable environmental and social conditions. When access to essential services depends on remaining within a particular territory or administrative system, changes in residence can interrupt the relationship between individuals and the institutions responsible for their protection.

Human mobility is not a new phenomenon. Migration, seasonal movement, pastoralism and trade have shaped societies throughout history. Many communities have developed forms of social organisation that accommodate movement without losing cultural continuity or collective identity. The historical development of modern territorial states, however, has strengthened the institutional relationship between citizenship, residence and access to public services.

Contemporary examples demonstrate that this relationship is not immutable. Within the European Union, freedom of movement and agreements on the coordination of social security systems allow people to live and work across national borders while retaining certain legal and social protections. These arrangements remain embedded in territorial states and are subject to political and legal limitations. Nevertheless, they illustrate how institutional cooperation can accommodate mobility without necessarily undermining social stability.

TEOS 2100 considers what might happen if mobility becomes a more persistent condition of life for substantial parts of the global population, rather than an activity accommodated within otherwise settled societies.

Climate change provides one possible driver of such a transformation. Rising temperatures, changing precipitation patterns, water insecurity and more frequent or severe environmental hazards can affect the conditions that sustain permanent settlements. Their consequences

interact with economic inequalities, demographic developments, political decisions and existing vulnerabilities. Where agriculture becomes less reliable, employment opportunities decline or essential infrastructure can no longer be maintained, households and communities may face increasing pressure to reconsider where and how they live.

These pressures will not affect all populations equally. Some people will be able to adapt without relocating. Others may move temporarily, establish livelihoods across several locations or migrate permanently. Those with limited resources, care responsibilities or restricted legal opportunities may find themselves unable to leave deteriorating conditions. Mobility and immobility may therefore become different expressions of the same underlying environmental and institutional pressures.

The implications extend beyond the movement of populations. If increasing numbers of people live across administrative boundaries, national borders or changing places of residence, established arrangements for providing public services and exercising political authority may become less effective.

A person who moves repeatedly may struggle to maintain educational continuity, recognised qualifications, healthcare coverage or access to social protection. Employment and income may depend on several jurisdictions. Legal identity and political participation may remain attached to a place where that person no longer lives. Receiving communities, meanwhile, may face additional demands on housing, infrastructure and public services without having the resources or institutional capacity to respond.

These difficulties do not arise from mobility alone. They emerge when institutions designed around relatively stable residence encounter forms of life that no longer conform to that expectation.

This distinction is central to TEOS 2100. The report does not assume that permanent settlement will disappear or that mobile societies will necessarily replace territorial states. It examines a possible future in which settlement becomes less reliable as the principal organising condition of social life. Under such circumstances, institutions may need to maintain relationships with people across changing locations rather than rely primarily on permanent residence.

The resulting questions concern the foundations of social organisation. How can public services remain accessible when people move between jurisdictions? How can legal rights, political representation and social protection be maintained across changing places of residence? How should access to land, water and infrastructure be negotiated between mobile populations and established communities? And how can societies protect the freedom to move without neglecting the rights of those who remain?

TEOS 2100 explores these questions through the possible long-term consequences of changing water systems in the Hindu Kush Himalayan region. The region provides a starting point for examining how environmental pressures might interact with demographic, economic and political developments to challenge existing settlement patterns.

The broader problem is institutional. If the conditions supporting permanent residence become less reliable, societies may need forms of governance, infrastructure and social protection that can function independently of a single fixed location.

The question is therefore not whether people will continue to move. They will. It is whether the institutions on which modern societies depend can adapt when mobility becomes a more enduring feature of social life.

1.2 The Trigger

The environmental starting point of TEOS 2100 is the long-term transformation of water systems in the Hindu Kush Himalayan region. We refer to this development as *Himalayan water collapse*, although the term does not describe a sudden or complete disappearance of freshwater. It describes a possible future in which changes in glaciers, snow cover, precipitation and seasonal river flows progressively undermine the reliability of water systems on which large populations depend.

The Hindu Kush Himalayan region is frequently described as one of Asia's major water towers. Its mountain systems contribute to several of the continent's largest river basins, including the Indus, Ganges, Brahmaputra, Irrawaddy, Salween, Mekong, Yangtze and Yellow River systems. These rivers connect mountainous environments with agricultural regions, industrial centres and densely populated urban areas across South, Central, East and Southeast Asia.

Their significance extends well beyond the availability of drinking water. River systems support irrigation, food production, hydropower, industrial activity, transport and ecological functions. The reliability of these systems has influenced where people live, how economic activities develop and which forms of infrastructure and governance become established.

Changes in water availability can therefore affect several dimensions of society simultaneously.

The geographical scale of these dependencies is substantial. According to the United Nations World Population Prospects 2024[1], the countries considered in this report could together have approximately 3.0 to 3.3 billion inhabitants by 2100 under the medium population projection.

This figure illustrates the demographic scale of the countries associated with the river systems examined in TEOS 2100. It does not represent the population directly dependent on Himalayan glacier melt, nor does it indicate how many people might experience displacement. Exposure varies considerably between and within countries, depending on river basin geography, local water sources, economic activities, infrastructure and institutional capacity.

[1] United Nations (2024). World Population Prospects 2024: Summary of Results. UN DESA/POP/2024/TR/NO. 9. New York: United Nations. https://desapublications.un.org/publications/world-population-prospects-2024-summary-results

Table 1: Demographic context of Himalayan-linked water systems

Source basis: United Nations, World Population Prospects 2024, medium variant. Values rounded for narrative use.

Note: Country-level population figures indicate demographic context rather than uniform exposure to Himalayan water insecurity. The geographic connections listed in the table do not imply that all parts of a country depend on the same mountain water sources.

Country	Main river system exposure	UN 2100 population, rounded
Afghanistan	Indus headwaters, Amu Darya links	110 to 125 million
Pakistan	Indus	500 to 520 million
India	Indus, Ganges, Brahmaputra	1.45 to 1.55 billion
Nepal	Ganges tributaries	25 to 30 million
Bhutan	Brahmaputra tributaries	0.5 to 0.8 million
Bangladesh	Ganges, Brahmaputra, Meghna delta	170 to 185 million
Myanmar	Irrawaddy, Salween	35 to 45 million
Thailand	Mekong, Salween	35 to 45 million
Laos	Mekong	9 to 12 million
Cambodia	Mekong, Tonle Sap	17 to 20 million
Vietnam	Mekong delta, Red River	70 to 80 million
China	Yangtze, Yellow River, Mekong, Salween, Brahmaputra	600 to 700 million
TOTAL		**3.0 to 3.3 billion**

Climate change is already altering the physical processes that regulate water availability in the region. Rising temperatures contribute to glacier retreat and changes in snow accumulation and melting. At the same time, changing precipitation patterns and extreme weather events affect the timing, volume and distribution of river flows.

These developments do not follow a uniform trajectory. In some glacier-fed catchments, accelerated melting may initially increase runoff and flood risks. As glacier mass continues to decline, the contribution of stored ice to river flow may subsequently decrease. Other areas may experience changes dominated by precipitation, groundwater availability or water management rather than glacier retreat alone.

The resulting challenge is therefore not simply a reduction in the total quantity of available water. It is also a loss of predictability.

Agricultural systems depend on water arriving at suitable times during the growing season. Hydropower facilities rely on river flows that can be managed within operational limits. Cities need dependable supplies for households, public services and economic activities. When seasonal patterns change or extreme events become more disruptive, existing infrastructure and management systems may become less effective.

These pressures interact with developments that are not primarily environmental. Population change, urban expansion, agricultural demand, industrial activity and political decisions influence how water is allocated and used. Economic inequalities affect the ability of

households and communities to adapt. Water infrastructure may offer protection in one location while creating additional dependencies or tensions elsewhere.

TEOS 2100 considers the combined effects of these processes.

Water insecurity can reduce agricultural productivity and weaken rural livelihoods. Changes in hydropower generation may affect electricity supplies and economic activity. Floods and droughts can damage infrastructure, disrupt transport and increase public expenditure. As these pressures accumulate, some communities may face declining employment opportunities, rising costs of living and reduced access to essential services.

None of these consequences automatically leads to the abandonment of permanent settlements. Communities may adapt by changing agricultural practices, investing in water storage, improving infrastructure or diversifying livelihoods. Their ability to do so depends on available resources, governance arrangements and the extent of environmental change.

However, adaptation has limits.

Where water systems become increasingly unreliable and the economic basis of a community deteriorates, maintaining permanent residence may become more difficult. Some households may respond through temporary migration or seasonal employment elsewhere. Others may relocate permanently. Communities with fewer financial or institutional resources may experience growing vulnerability without being able to move.

Over several generations, these developments could change settlement patterns across affected regions. Movement might become a recurring part of economic and family life rather than an exceptional response to environmental disasters.

This is the scenario explored in TEOS 2100.

Himalayan water collapse is not presented as a single future event that inevitably triggers mass migration. It is a possible cumulative process through which changing environmental conditions interact with economic pressures, demographic developments and political decisions.

Its significance for this report lies in the connection between water reliability and the viability of permanent settlement.

Water sustains agriculture, energy production, employment and everyday life. When the conditions supporting these activities become less reliable, the institutions and infrastructure built around them may also come under pressure.

TEOS 2100 therefore begins with Himalayan water systems, but its central question extends further: what happens to societies when the environmental foundations of permanent settlement can no longer be assumed to remain stable?

1.3 The Foresight Lens

TEOS 2100 examines a future that has not yet occurred, but whose underlying pressures are already becoming visible. Glacier retreat, changing water availability, demographic

developments, economic dependencies and political tensions provide evidence of processes that may influence human societies over the coming decades. How these processes will interact, and what consequences they will produce by 2100, remains uncertain.

This uncertainty is the starting point of our foresight approach.

Foresight does not attempt to establish one definitive picture of the future. It examines possible developments by considering existing knowledge, emerging trends and the decisions that may influence their direction. Its value lies in exploring consequences that are difficult to recognise when environmental, economic and political developments are considered separately.

TEOS 2100 applies this perspective to the relationship between environmental change, human mobility and social organisation. The report draws on existing scientific research, demographic projections, observed patterns of migration and current institutional arrangements. These provide the basis for examining how continued environmental pressures could affect the conditions supporting permanent settlement.

We consider the emergence of post-settlement forms of social organisation a plausible development that deserves serious attention. The environmental and societal pressures underlying this possibility are already observable. Nevertheless, their continuation does not establish that a particular institutional transformation will occur. The future will also depend on adaptation measures, technological developments, political decisions and the ability of communities to respond.

Our analysis therefore distinguishes between three levels of knowledge.

The first consists of findings supported by existing research. These include observed changes in mountain environments, documented relationships between environmental conditions and human livelihoods, and current patterns of migration and governance.

The second concerns projections and assumptions about developments that may continue or change over time. Demographic projections, possible changes in water availability and the responses of governments and communities belong to this category. Their relevance depends on the assumptions and conditions under which they are considered.

The third level concerns the construction of possible futures. Here, the report examines how environmental pressures and institutional responses might combine to produce different forms of social organisation. These futures are exploratory rather than predictive. They allow us to investigate consequences that cannot be observed directly today.

The year 2100 provides a common horizon for this analysis. Changes in glaciers, water infrastructure, settlement patterns and political institutions often unfold over several decades. A shorter time frame might capture immediate environmental and economic consequences while overlooking changes that develop gradually across generations.

The long-term perspective also allows us to consider relationships that may change over time. Environmental pressures can influence livelihoods, migration and settlement patterns. These developments may alter economic opportunities, public finances and demands on infrastructure. Political institutions may respond through cooperation, regulation, exclusion or

new forms of governance. The outcomes of these responses can, in turn, influence the ability of communities to adapt to further environmental change.

Such relationships are neither uniform nor necessarily linear. Similar environmental conditions may produce different social consequences depending on local resources, institutional capacity, inequality and political choices. Conversely, societies experiencing different environmental pressures may develop comparable responses to mobility and resource insecurity.

TEOS 2100 explores these possibilities through four scenarios: *Fortress Earth*, *Negotiated Mobility*, *Networked Nomads* and *Planetary Transition*. They examine contrasting ways in which governance, technology, resource distribution and human mobility could develop under sustained environmental pressure. The scenarios are not intended to represent successive stages of a single future. They provide alternative perspectives on how societies might respond to changing conditions.

The report also uses fictional accounts of people living in 2100 to examine the human consequences of these possible developments. Within each narrative, the conditions of the associated scenario are treated as an established reality. The characters encounter institutions, technologies and social arrangements that have emerged over previous decades. Their experiences reveal how these arrangements might affect everyday decisions, opportunities and relationships.

This narrative approach serves a different purpose from the scientific analysis. The stories do not provide evidence that a particular future will occur. They make the implications of the scenarios more concrete by exploring how people might experience them from within.

The foresight perspective also establishes limits to what the report can conclude. TEOS 2100 does not calculate the probability of a post-settlement future. Nor does it provide a quantitative model of glacier loss, river discharge, migration flows or institutional transformation. Its contribution lies in connecting findings from different fields and examining the consequences of their possible interaction.

The objective is therefore not to determine where people will live in 2100 or which form of governance will prevail. It is to identify developments that could challenge established institutions and to consider how different responses might affect social stability, access to resources and human rights.

From this perspective, the future of settlement becomes a question of present responsibility. Decisions about water management, infrastructure, migration, education, social protection and international cooperation will influence the opportunities available to future generations.

Foresight provides a way to examine these choices before their consequences become irreversible.

1.4 Key Concepts

TEOS 2100 uses seven key concepts to examine the relationship between environmental change, human mobility and social organisation. Some refer to established forms of human

activity or institutional arrangements. Others provide an analytical framework for exploring possible developments towards the year 2100.

The definitions below establish how these terms are used throughout the report.

Settlement

Settlement refers to a form of human habitation and social organisation in which people establish relatively permanent relationships with particular places.

In TEOS 2100, the term extends beyond physical residence. It describes an institutional arrangement in which territory and stable residence provide the principal basis for organising public services, economic activities, infrastructure, legal rights and political participation.

Modern states and their administrative systems largely operate within this framework. Schools, healthcare facilities, housing markets, public infrastructure and social protection systems are commonly organised around geographically defined populations. Residence and territorial jurisdiction determine which institutions are responsible for providing services and exercising authority.

Settlement does not imply the absence of mobility. People may travel, migrate or maintain relationships across borders while continuing to participate in institutions organised around permanent residence.

Post-settlement

Post-settlement describes a possible condition in which permanent residence becomes less reliable as the principal basis for organising social life.

The term does not suggest that cities, territorial states or permanent homes disappear. Rather, it refers to circumstances in which substantial parts of the population live across several locations, move repeatedly or depend on forms of economic and social activity that are not tied to a single place.

Under these conditions, institutions organised primarily around fixed residence may encounter difficulties maintaining access to education, healthcare, employment, legal protection and political participation.

TEOS 2100 uses post-settlement as an analytical concept rather than a prediction or a predefined stage of human development. It allows us to examine how institutions might adapt when the relationship between people, residence and territory undergoes substantial change.

Mobility

Mobility refers to the movement of people across geographical space and the social arrangements associated with that movement.

In TEOS 2100, it encompasses voluntary migration, displacement, planned relocation, seasonal migration, circular movement and livelihoods maintained across several locations. These forms differ in their causes, duration, legal circumstances and consequences.

Mobility may provide opportunities for adaptation, employment and social exchange. It may also result from coercion, environmental deterioration, economic hardship or conflict. The ability to move safely depends on access to resources, legal rights, social networks and institutional support.

The report therefore does not treat mobility as inherently beneficial or harmful. It examines the conditions under which movement expands or restricts people's opportunities.

Mobility must also be considered alongside immobility. Some individuals and communities cannot relocate, while others choose to remain because of family responsibilities, cultural connections, economic circumstances or attachment to place.

Post-territorial civilisation

Post-territorial civilisation describes a possible form of social organisation in which rights, services, economic participation and collective identity depend less exclusively on membership of a single territorial jurisdiction.

This does not imply the disappearance of territory or the abolition of states. Land, borders, natural resources and political sovereignty remain significant. However, institutions may increasingly need to coordinate responsibilities across geographical and administrative boundaries.

In a post-territorial arrangement, individuals could maintain access to recognised qualifications, healthcare, social protection and forms of political participation while living or working across different jurisdictions.

TEOS 2100 distinguishes this concept from post-settlement. Post-settlement describes a change in the relationship between people and permanent residence. Post-territorial civilisation concerns the possible institutional and political arrangements that emerge in response.

A society may experience increasing mobility without developing effective post-territorial governance. Conversely, certain post-territorial arrangements may develop within societies where most people continue to live permanently in one place.

Social order

Social order refers to the institutional arrangements, shared rules and social relationships that allow people to coexist, coordinate activities and manage conflicts.

It includes formal institutions such as legal systems, public administration and political representation, as well as informal structures based on trust, cultural practices, social networks and mutual responsibilities.

Social order does not require the absence of disagreement or conflict. It depends on the existence of mechanisms through which competing interests can be negotiated and collective decisions can be implemented.

In TEOS 2100, social order provides a central perspective for examining the consequences of environmental change and human mobility. The report asks how societies can maintain essential functions, protect rights and enable participation when established relationships between people, institutions and territory become less stable.

Balance-orientation

Balance-orientation describes the capacity of individuals, communities and institutions to recognise and negotiate relationships between different needs, interests and limits.

In the understanding of sustainability applied by TEOS 2100, it concerns the relationship between individual freedom, collective responsibility, cultural context and ecological conditions.

Balance-orientation does not imply that competing interests can always be reconciled or that a permanent equilibrium can be achieved. Environmental, social and economic conditions change, and decisions frequently involve trade-offs.

The concept instead emphasises the ability to identify these tensions, involve affected groups and develop arrangements that remain workable under changing circumstances.

In a post-settlement future, balance-orientation becomes relevant to questions of resource allocation, mobility rights, the interests of receiving communities, political participation and conflict resolution.

Himalayan water collapse

Himalayan water collapse refers to the possible long-term destabilisation of water systems associated with the Himalayas and the wider Hindu Kush Himalayan region.

The term does not describe a single catastrophic event or the complete disappearance of freshwater. It refers to cumulative changes in glacier mass, snow cover, precipitation, seasonal river flows and water availability that could undermine the reliability of water-dependent economic and social systems.

The consequences would differ between river basins, ecological zones and communities. Some areas may initially experience increased meltwater runoff and flood risks. Others may face declining dry-season water availability, changing agricultural conditions or growing pressure on energy and urban infrastructure.

TEOS 2100 uses Himalayan water collapse as the environmental starting condition of its long-term foresight analysis. It is not presented as an inevitable outcome or as a quantified prediction.

The concept allows the report to examine how persistent changes in water reliability could interact with demographic developments, economic dependencies, political decisions and institutional capacity to influence future settlement patterns.

1.5 Scope and Limits

TEOS 2100 examines a possible long-term transformation of human settlement and social organisation under conditions of environmental change. Its starting point is the increasing pressure on water systems associated with the Himalayas and the wider Hindu Kush Himalayan region. The report explores how these pressures could interact with economic, demographic and political developments and, over several generations, challenge institutions built around permanent residence.

The geographical focus is deliberately defined, but the questions arising from it extend beyond the region itself.

The Hindu Kush Himalayan region provides the environmental foundation of the analysis. Its mountain water systems contribute to major Asian river basins, including the Indus, Ganges, Brahmaputra, Irrawaddy, Salween, Mekong, Yangtze and Yellow River systems. Changes in water availability and seasonal river flows may affect agricultural regions, urban centres and economic activities far beyond the mountains.

TEOS 2100 considers these wider relationships without attempting to provide an equally detailed assessment of every country or river basin. The exposure of communities to water insecurity depends on geographical conditions, economic activities, infrastructure, governance and adaptive capacity. The report therefore does not assume that environmental changes will affect all populations in the same way or produce comparable consequences across the region.

The temporal horizon is the year 2100. This allows the analysis to consider developments that may unfold gradually and whose institutional consequences might not become apparent within conventional planning periods. Changes in glaciers, water systems, economic structures and settlement patterns can take decades. The adaptation of political and social institutions may occur over similarly long periods.

The report examines these developments through an interdisciplinary perspective, drawing on research concerning climate change, water systems, migration, demography, economic activity and governance. It connects existing findings to explore possible consequences for social organisation.

TEOS 2100 does not present an independent hydrological or demographic model. It does not calculate future glacier mass, river discharge or migration flows. Nor does it determine how many people will become displaced or how many settlements may cease to be viable by 2100. Quantitative projections included in the report provide context for the scenarios and remain subject to the assumptions and limitations of their original sources.

The analysis also does not establish a numerical probability for the emergence of a post-settlement civilisation. We consider such a development plausible in view of the

environmental and societal pressures examined, but its occurrence, extent and institutional characteristics remain uncertain.

The report approaches this uncertainty through four contrasting scenarios. *Fortress Earth*, *Negotiated Mobility*, *Networked Nomads* and *Planetary Transition* explore different possible responses to environmental insecurity, mobility and changing relationships between populations and territory.

These scenarios do not represent a comprehensive account of every possible future. They provide selected perspectives through which institutional choices, social consequences and potential conflicts can be examined. Their purpose is to make alternative developments understandable and to identify questions that deserve attention in present-day planning and policy.

The fictional accounts in Chapter 7 extend this analysis to individual experiences. They describe people living under the established conditions of particular scenarios in 2100. These narratives are intended to explore possible consequences for everyday life, including access to resources, employment, education, family relationships and individual freedom. They are not empirical case studies or independent evidence of future developments.

The report also addresses longer-term implications for human development, planetary boundaries and the possibility of life beyond Earth. These considerations form an exploratory extension of the central analysis. They do not imply that environmental pressures on Earth will necessarily lead to space settlement or that technological expansion can replace the need to address ecological and social problems on this planet.

An additional limitation concerns the relationship between environmental change and human mobility. Migration rarely results from a single cause. Economic opportunities, social networks, political decisions, cultural attachments and individual circumstances influence whether people move, remain or adopt forms of life across several locations. TEOS 2100 therefore does not treat migration as an inevitable consequence of water insecurity.

Nor does it assume that a post-settlement civilisation would necessarily be desirable. Greater mobility may create opportunities for adaptation and cooperation, but it may also produce exclusion, unequal access to resources, weakened rights and new forms of institutional control. The capacity to remain in a chosen place must be considered alongside the freedom to move.

The central concern of TEOS 2100 is the relationship between changing environmental conditions and the institutions through which societies organise collective life.

The report asks how access to water, food, employment, education, healthcare, legal protection and political participation might be maintained if permanent residence becomes less reliable as a basis for social organisation. It examines what different institutional responses could mean for human dignity, social stability and the ability of communities to adapt.

Its contribution lies in bringing these questions together within a long-term foresight framework. Rather than identifying a predetermined future, TEOS 2100 seeks to clarify

possible developments and their consequences while there is still scope for political, institutional and societal choices.

1.6 Structure of the Report

TEOS 2100 is organised into eight chapters that examine the relationship between environmental change, human mobility and the possible transformation of social organisation by the end of the twenty-first century.

The report moves from the scientific and societal foundations of the problem to its potential institutional consequences. It then explores alternative futures and examines what these developments could mean for people living in 2100.

Chapter 1 - Introduction: Why Settlement Becomes a Question

The opening chapter establishes the central problem and explains why permanent settlement may become a less reliable basis for organising society. It introduces the transformation of Himalayan water systems as the environmental starting point of the investigation, defines the key concepts and outlines the foresight approach. The chapter also establishes the geographical, temporal and methodological boundaries of the report.

Chapter 2 - The Great Melt

This chapter examines the environmental foundations of the scenario. It considers glacier retreat in the Hindu Kush Himalayan region and the consequences of changing water availability for major Asian river basins. Particular attention is given to water security, agriculture, food production, energy generation and economic livelihoods. The chapter distinguishes between observed environmental developments and possible longer-term consequences, providing the scientific context for the subsequent analysis.

Chapter 3 - The Age of Displacement

Chapter 3 explores how environmental change interacts with human mobility. It examines internal and cross-border migration, urbanisation, climate-related displacement and the legal status of people who move under environmental pressure. Border governance and security implications are also considered. The analysis recognises that migration has multiple causes and that the ability to relocate depends on economic resources, social networks, political conditions and legal opportunities.

Chapter 4 - The End of Settlement

The fourth chapter develops the central argument of TEOS 2100. It examines how environmental and institutional pressures could progressively undermine the viability of permanent settlement. The analysis considers thresholds of habitability, increasing pressure on receiving regions, competition for resources and changing relationships between land ownership and temporary access. It also explores how mobile forms of social organisation could emerge as established settlement patterns become more difficult to maintain.

Chapter 5 - Building a Post-Settlement Civilisation

Chapter 5 examines the institutional implications of a society in which permanent residence no longer provides the principal basis for organising all aspects of collective life. It considers governance, sovereignty, education, economic systems, social cohesion, mobility and technology. The chapter explores how institutions might maintain rights, public services and opportunities for participation across changing locations. It also considers the risks of exclusion, unequal access and new forms of dependency.

Chapter 6 - Four Futures of 2100

The sixth chapter brings the preceding analysis together through four alternative scenarios: *Fortress Earth*, *Negotiated Mobility*, *Networked Nomads* and *Planetary Transition*.

Each scenario examines a different possible response to environmental insecurity, population mobility and changing relationships between people, resources and territory. They consider contrasting arrangements of political authority, institutional cooperation, technology and social inclusion.

The scenarios are not predictions or consecutive stages of a single development. They are constructed futures intended to explore how different political and institutional choices might influence life in 2100. A comparative analysis identifies their principal differences and implications.

Chapter 7 - Human Stories from 2100

Chapter 7 examines the human consequences of the scenarios through fictional accounts of people living in the year 2100.

The stories describe the everyday experiences of individuals and families whose lives are shaped by different forms of mobility, resource access and institutional organisation. They include educators, diplomats, entrepreneurs, mobile families, young people and individuals whose responsibilities prevent them from moving freely.

Within each story, the conditions of the associated scenario are treated as an established reality. The narratives explore how future inhabitants might experience these conditions, respond to constraints and make decisions affecting their livelihoods, relationships and opportunities.

Their purpose is not to predict individual lives, but to make the possible consequences of institutional arrangements more tangible.

Chapter 8 - From Nomads to the Stars

The final chapter extends the analysis to broader questions of human adaptability and long-term societal development.

It examines mobility as a possible capacity of future civilisations and considers the institutional, technological and cultural requirements of societies organised across changing locations. Themes include portable rights and public services, modular infrastructure,

resource management, planetary boundaries and governance beyond fixed territorial arrangements.

The chapter also explores potential connections between adaptation on Earth and the requirements of future human activities beyond the planet. These considerations are presented as an exploratory extension of the report, rather than an inevitable outcome of environmental change.

The chapter concludes by examining the strategic implications of post-settlement futures for present-day institutions and the continuing importance of human dignity, participation and belonging.

Methodological Annex

The Methodological Annex documents the analytical approach underlying the report. It explains the use and interpretation of scientific evidence, demographic projections and qualitative scenarios, as well as the role of the fictional narratives and the limitations of the analysis.

It explains how existing research, demographic projections and other evidence informed the foresight analysis, identify the assumptions used in developing the scenarios and describe the criteria applied to their comparison. The annex also clarifies the relationship between the analytical scenarios and the fictional narratives in Chapter 7, allowing readers to distinguish the scientific foundations of the report from its exploratory elements.

The Executive Summary and Key Findings appear at the beginning of the publication to provide an overview of the main arguments and their strategic implications.

Throughout the report, TEOS 2100 maintains a distinction between observed developments, evidence-informed assumptions and possible futures. Its purpose is to examine how choices made under present conditions could influence the ability of future societies to maintain essential functions, protect rights and sustain social relationships.

The question guiding the investigation remains the same: how might human societies organise themselves if permanent settlement can no longer be taken for granted?

2. The Great Melt

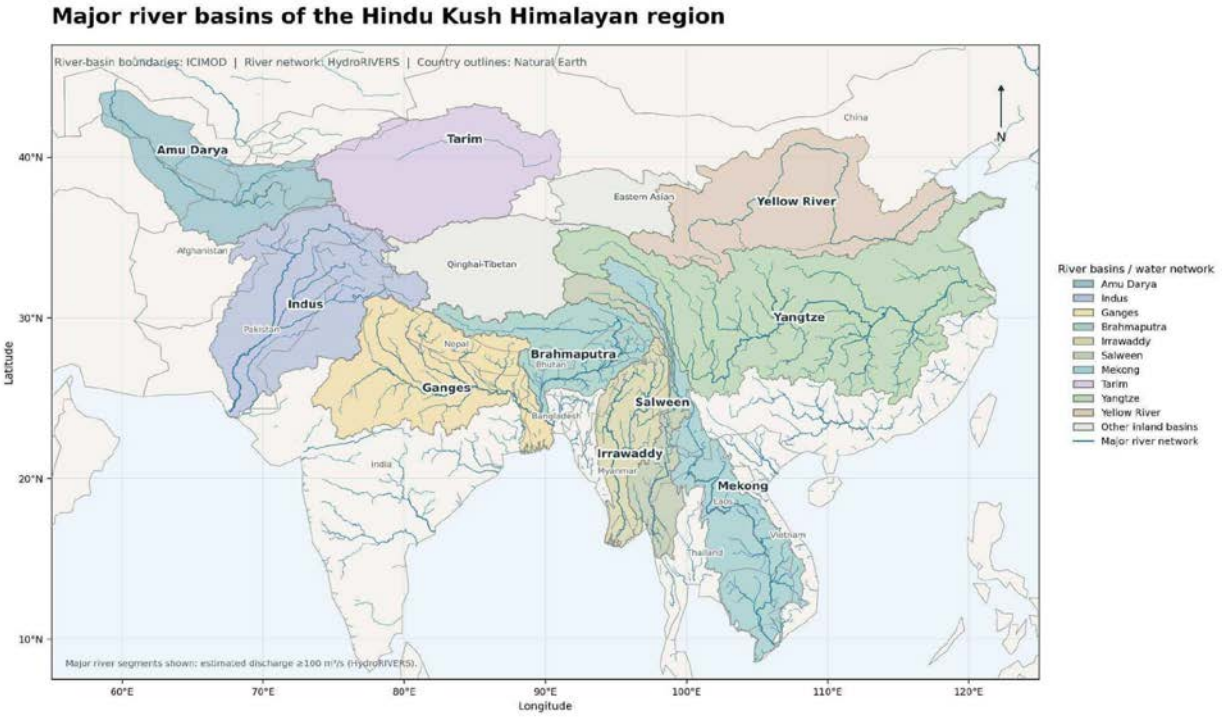
2.1 Himalayan Glacier Systems

Glaciers are among the most visible indicators of climate change. Their retreat reflects changes in temperature and precipitation over extended periods and provides evidence of how mountain environments are responding to global warming. The consequences extend beyond the loss of ice. Glaciers influence river flows, freshwater availability and the stability of landscapes on which human communities depend.[2]

The Hindu Kush Himalayan (HKH) region contains one of the world's largest concentrations of snow and ice outside the polar regions. Often referred to as the *Third Pole* or the *water towers of Asia*, its mountain systems extend across several countries and contribute to major river basins. The region includes the Himalayas as well as neighbouring high mountain ranges, whose glaciers and seasonal snow cover play an important role in regulating water availability.[3]

Figure 1: Major river basins of the Hindu Kush Himalayan region.

Own cartographic representation based on ICIMOD (2021), HydroRIVERS v1.0 (Lehner & Grill, 2013), and Natural Earth. Major river segments are selected using a minimum estimated discharge of 100 m³/s.



These mountain water systems support communities in the highlands and contribute to rivers that sustain agriculture, energy production, ecosystems and urban populations far

[2] International Centre for Integrated Mountain Development (ICIMOD) (2023). Water, Ice, Society, and Ecosystems in the Hindu Kush Himalaya: An Outlook.
[3] Silwal, G. (2025). *Why should we care about Himalayan glaciers?* Newcastle University. Retrieved August 6, 2026, from https://from.ncl.ac.uk/why-should-we-care-about-himalayan-glaciers

downstream. The Indus, Ganges and Brahmaputra are among the most prominent examples. Other major river systems, including the Mekong, Salween and Yangtze, are connected to the wider HKH region.

The significance of these systems lies partly in their capacity to store water in the form of snow and ice and release it over time. During colder periods, precipitation accumulates in mountain environments. As temperatures rise, snowmelt and glacier melt contribute to river discharge. This seasonal process can provide water when rainfall is limited, although the relative importance of glacier melt varies considerably between river basins.[4]

Climate change is altering this relationship.

According to the *Water, Ice, Society, and Ecosystems in the Hindu Kush Himalaya* assessment published by the International Centre for Integrated Mountain Development (ICIMOD) in 2023, glacier mass loss in the region accelerated substantially during the first two decades of the twenty-first century. The average annual rate increased from approximately 0.17 metres of water equivalent in 2000 - 2009 to 0.28 metres in 2010 - 2019, representing an increase of around 65 percent.

The same assessment projects substantial additional losses by 2100. Depending on the level of global warming, glaciers could lose between 30 and 50 percent of their 2015 volume under warming of 1.5 - 2 °C, while warming of 4 °C could result in losses of 70 - 80 percent. These projections illustrate the sensitivity of mountain ice reserves to future temperature developments. They do not imply that all glaciers will disappear or that every river basin will experience the same consequences.[5]

The effects of glacier retreat also change over time. In some catchments, accelerated melting may initially increase river discharge. This can temporarily raise water availability, while also contributing to higher flood risks. As glacier volumes decline, the amount of stored ice available for future melting decreases. The contribution of glacier melt to downstream water supplies may then diminish.

This process is often described as *peak water*: a period during which glacier runoff reaches a maximum before declining as the remaining ice reserves become smaller. Its timing differs between glaciers and river basins. The consequences also depend on precipitation, seasonal snow cover, groundwater and human water management.

Glacier retreat creates additional risks in high mountain environments. As glaciers shrink, meltwater can accumulate in lakes that are sometimes contained by unstable deposits of rock and sediment. A sudden failure of these natural barriers can release large quantities of

[4] Xu, J., Grumbine, R. E., Shrestha, A., Eriksson, M., Yang, X., Wang, Y., & Wilkes, A. (2009). The melting Himalayas: Cascading effects of climate change on water, biodiversity, and livelihoods. *Conservation Biology, 23*(3), 520–530. Retrieved August 6, 2026, from https://doi.org/10.1111/j.1523-1739.2009.01237.x

[5] ICIMOD (2023). Water, Ice, Society, and Ecosystems in the Hindu Kush Himalaya: An Outlook, Chapter „Ice“. https://www.researchgate.net/publication/371731505_Water_ice_society_and_ecosystems_in_the_Hindu_Kush_Himalaya_An_outlook

water and debris downstream. Such events are known as *Glacial Lake Outburst Floods* (GLOFs).

Other hazards can arise from the destabilisation of steep mountain slopes and the collapse of rock and glacier ice. These events may trigger avalanches and debris flows, temporarily obstruct rivers and generate destructive flooding. Their consequences can extend far beyond the original failure site, affecting settlements, transport infrastructure, hydropower facilities and communities across national borders.

A recent example occurred on 26 August 2026 in the Langtang region near the Nepal–China border. A massive rock-and-ice collapse on the northern flank of Langtang Lirung triggered a rapidly moving debris flow that travelled through the Lhende Khola valley and devastated parts of the Gyirong–Rasuwagadhi border corridor. According to a preliminary scientific assessment published by ICIMOD in October 2026, approximately 132 million cubic metres of rock and glacier ice detached from the mountain. Satellite radar observations had detected substantial ground deformation in the weeks preceding the collapse. The disaster caused extensive loss of life and severe damage to settlements and infrastructure in both countries.[6]

The event illustrates how instability in high mountain environments can develop into a cascading disaster involving rock, ice, water and sediment. It also exposed limitations in existing early-warning systems. The destructive surge reached the border corridor within minutes, leaving little time for authorities to identify the danger and communicate effective warnings. Although the region is experiencing substantial environmental change, the precise contribution of climate change to this individual event has not been established.

The disaster demonstrates the need for monitoring systems that combine satellite observations, seismic measurements and hydrological information. It also highlights the importance of transboundary cooperation, as mountain hazards and their consequences do not follow national borders.[6]

The event demonstrates how changes and failures within high mountain water systems can have consequences far downstream. It also illustrates the importance of transboundary monitoring and early-warning arrangements.

The expansion and development of glacial lakes require continued scientific observation. However, the presence or growth of a lake does not automatically mean that an outburst will occur. Risk depends on factors such as lake volume, surrounding terrain, the stability of natural barriers and the exposure of downstream communities.

As mountain environments continue to warm, glacier retreat and changes in glacial lakes are expected to create additional challenges for communities and infrastructure. The ICIMOD assessment identifies increasing risks from floods, landslides and changes in the mountain cryosphere, alongside longer-term pressures on water availability and livelihoods.[7]

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[6] International Centre for Integrated Mountain Development (ICIMOD). (2026). *Understanding the Gyirong–Rasuwa Disaster of 26 August 2026: A Preliminary Synthesis*. Kathmandu: ICIMOD. https://lib.icimod.org/records/qdvc1-tc123

[7] ICIMOD (2023). Water, Ice, Society, and Ecosystems in the Hindu Kush Himalaya: An Outlook.

Communities in the Himalayas have developed different ways of adapting to seasonal water scarcity. One example comes from Ladakh, a cold and arid high-altitude region in northern India, where limited water availability during the spring can constrain agricultural production.

Artificial ice reservoirs, commonly known as *ice stupas*, offer a local response to this problem. During winter, water is directed through pipes and allowed to freeze into conical structures. The stored ice melts gradually as temperatures rise, providing water during the early agricultural season when natural supplies may be insufficient.

The modern ice stupa technique was developed in Ladakh in the 2010s, building on earlier regional practices of artificial glacier creation and winter water storage. Its design allows communities to store water using low temperatures and gravity, with relatively limited energy requirements.[8]

Ice stupas cannot replace natural glaciers or compensate for the large-scale transformation of Himalayan water systems. Their value lies in responding to specific seasonal shortages and demonstrating how local knowledge and technical innovation can support adaptation.

Such measures also reveal the limits of adaptation. Local water storage, changes in agriculture and improved infrastructure may help communities manage environmental pressures, but their effectiveness depends on available water, technical capacity, financial resources and institutional support.

For TEOS 2100, the significance of Himalayan glacier retreat lies in its long-term effects on the reliability of water systems. Glaciers do not need to disappear completely for these effects to become serious. Changes in seasonal runoff, increasing exposure to hazards and reduced water availability during critical periods may already undermine the conditions on which agricultural livelihoods and infrastructure depend.

The resulting pressures are unlikely to follow a uniform path. Some communities may adapt successfully, while others face repeated disruption or declining economic opportunities. Over several generations, these differences could influence decisions about residence, employment and migration.

Glacier retreat is therefore one component of the environmental process examined in TEOS 2100. Its wider significance emerges through the interaction of changing water availability, economic dependence and institutional capacity.

Understanding this interaction requires moving beyond the glaciers themselves to examine the river basins through which their effects reach much larger populations.

2.2 River Basin Impacts

The consequences of Himalayan glacier retreat extend far beyond the mountain environments in which they originate. Major Asian river systems connect high-altitude glaciers and snow-covered regions with agricultural plains, urban settlements and industrial

[8] Council on Energy, Environment and Water (CEEW) (2024). Ice Stupa: Artificial Glaciers.

centres. Changes in the timing and availability of water can therefore affect economic activities and livelihoods across entire river basins.

The significance of these changes depends on how individual river systems are supplied. Glacier melt, seasonal snowmelt, rainfall and groundwater contribute to river discharge in different proportions. Their relative importance also varies throughout the year. As a result, climate change does not produce a uniform pattern of increasing or declining water availability across the Hindu Kush Himalayan region.[9]

The Indus, Ganges and Brahmaputra illustrate these differences. All three originate in or receive water from high mountain environments, but their hydrological characteristics differ considerably.

The Indus basin is strongly influenced by snow and glacier melt, particularly in its upper catchments. Water stored in mountain snow and ice contributes to river discharge during warmer months and supports extensive irrigation systems downstream. Changes in the timing and volume of meltwater can therefore affect agricultural production and the management of reservoirs and hydropower facilities.

The Ganges and Brahmaputra basins receive a larger proportion of their annual runoff from rainfall, much of it associated with the South Asian monsoon. Snow and glacier melt remain relevant, especially in mountainous tributaries and during periods when precipitation is limited. However, the long-term development of these river systems will depend on changes in rainfall as well as the retreat of glaciers.[10]

These differences make the timing of water availability as significant as the total quantity of water flowing through a river.

Agriculture depends on water being available during specific stages of crop development. Hydropower facilities require river discharge that can be managed within operational limits. Urban water systems must maintain reliable supplies despite fluctuations in seasonal demand. Changes in runoff may disrupt these activities even where annual water availability does not decline substantially.

In some glacier-fed catchments, accelerated melting may initially increase river discharge. Over time, continued glacier retreat reduces the volume of ice available to sustain meltwater contributions. This can lead to declining glacier runoff after a catchment has passed its period of peak water.

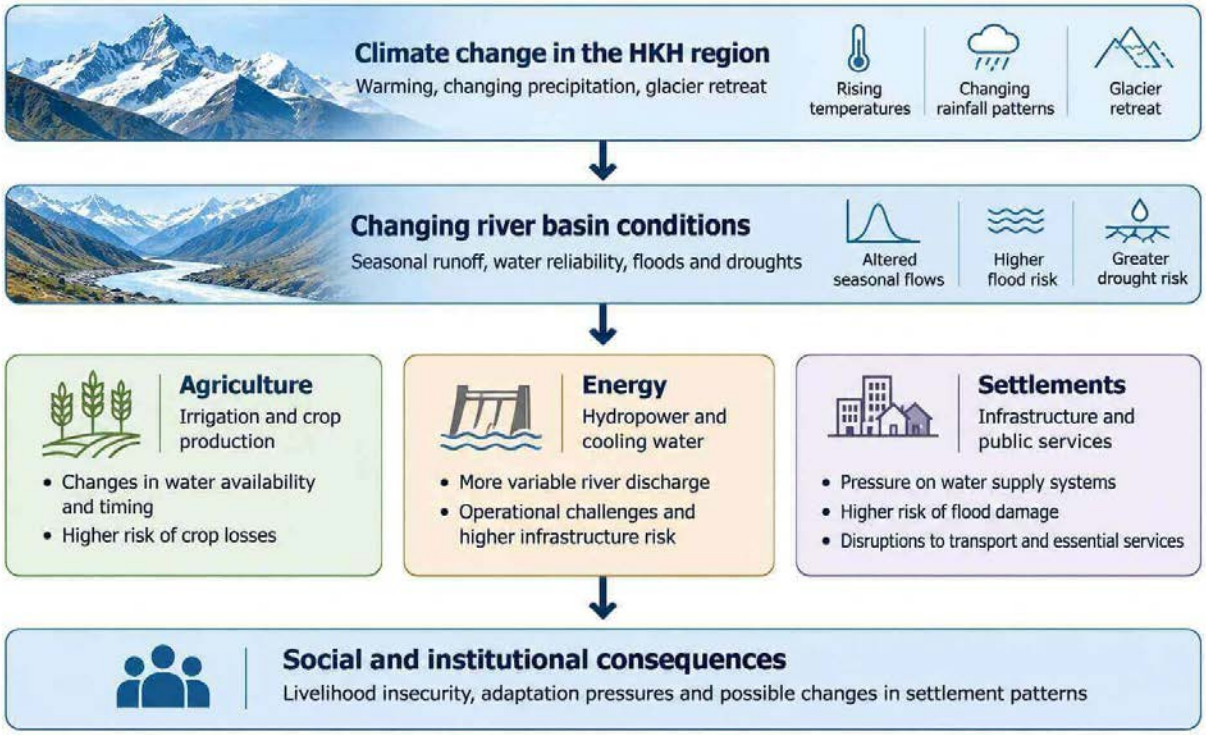
The timing of this transition varies between catchments. It is also affected by changes in snowfall, rainfall and temperature. Some river basins may experience greater annual runoff

[9] BBC News (2019). *Climate change: Warming threatens Himalayan glaciers*. https://www.bbc.com/news/science-environment-47122641
See also Intergovernmental Panel on Climate Change (IPCC) (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Working Group II, Chapter 10: Asia. https://www.ipcc.ch/report/ar6/wg2/chapter/chapter-10/

[10] Tayal, S., & Sarkar, S. K. (2019). *Climate change impacts on Himalayan glaciers and implications on energy security of the country*. The Energy and Resources Institute. Retrieved August 6, 2026, from https://www.teriin.org/sites/default/files/2019-11/cc-impact-himalayan-glacier.pdf

under particular climate scenarios, while also facing more pronounced seasonal fluctuations and higher exposure to extreme events.[11]

Figure 2: Possible cascading effects of climate change on Himalayan river basins and associated social-ecological systems.
Own conceptual representation based on the scientific literature reviewed in Chapter 2.



Flooding represents another consequence of changing river basin conditions. Intense precipitation, rapid snowmelt and glacial lake outburst floods can damage settlements, agricultural land and infrastructure. Higher sediment loads and changes in river channels may create additional difficulties for water storage, transport and hydropower operations.

Water shortages and flooding should therefore not be understood as mutually exclusive developments. The same river basin may experience excessive water during one part of the year and insufficient supplies during another. Existing infrastructure may be unable to accommodate these changes without substantial adaptation.

The relationship between water and energy illustrates the economic significance of river basin stability.

A 2019 assessment by The Energy and Resources Institute (TERI) estimated that approximately 33 percent of India's thermal power generation capacity and 52 percent of its hydropower capacity depended on water from rivers originating in the Himalayas. These

[11] Matta, G., Kumar, A., Tomar, D. S., & Kumar, R. (2025). Climate change in the Himalayan region: Susceptible impacts on environment and human settlements. *Frontiers in Environmental Science, 13*. Retrieved August 6, 2026, from https://doi.org/10.3389/fenvs.2025.1550843

figures describe the dependence of energy infrastructure on Himalayan-linked river systems, not the proportion of electricity generated directly from glacier meltwater.[12]

Thermal power plants require water for cooling and other operational processes, while hydropower facilities depend on river discharge and available hydraulic head. Variability in water availability can therefore affect energy production, particularly during periods of drought or when extreme events damage infrastructure.

The consequences extend beyond electricity generation. Energy shortages can affect manufacturing, transport, irrigation and public services. Reduced agricultural productivity may weaken household incomes and increase pressure on food markets. In urban areas, unreliable water and energy supplies can raise operating costs and strain public infrastructure.

Such effects are shaped by existing economic and institutional conditions. Communities with effective water management, diversified energy systems and adequate financial resources may be better able to respond. Others may experience repeated disruptions that gradually reduce their capacity to sustain livelihoods.

River basin management also involves political boundaries. Major rivers often flow through more than one country, creating relationships between upstream and downstream users. Decisions about water storage, hydropower development, irrigation and environmental protection can influence conditions beyond the jurisdiction in which they are made.

Climate change may increase the need for coordination, particularly where river flows become less predictable. Monitoring systems, hydrological data exchange and agreements on shared water resources can help governments and communities anticipate changes and manage competing demands.

For TEOS 2100, the wider significance of these developments lies in their possible cumulative consequences.

A single drought or flood does not necessarily undermine the viability of permanent settlement. However, repeated disruptions to agriculture, energy supply and essential infrastructure can gradually affect economic opportunities and the capacity of communities to adapt. Where these pressures persist, some households may seek employment across different locations or consider relocation.

The transformation of river basin conditions therefore provides a connection between the environmental changes examined in this chapter and the possible changes in human mobility explored later in the report.

The central concern is not that Himalayan rivers will cease to exist. It is that the water systems supporting established patterns of production, infrastructure and residence may become less reliable over time.

[12] Tayal, S., & Sarkar, S. K. (2019). *Climate Change Impacts on Himalayan Glaciers and Implications on Energy Security of the Country*. The Energy and Resources Institute (TERI). https://www.teriin.org/sites/default/files/2019-11/cc-impact-himalayan-glacier.pdf

2.3 Water Security

Water security depends on more than the total amount of freshwater available in a region. It also concerns whether water can be accessed reliably, whether its quality is sufficient for human use, and whether institutions and infrastructure can maintain supplies under changing environmental conditions.

In the Hindu Kush Himalayan (HKH) region, these questions are closely connected to the transformation of mountain water systems. Glaciers and seasonal snow cover contribute to river discharge, while rainfall and groundwater provide additional sources of water for communities in the mountains and downstream. The relative importance of these sources varies between locations and throughout the year.

Climate change is altering the conditions under which these water resources are replenished and distributed. Rising temperatures accelerate glacier retreat and influence snow accumulation and melting. Changes in precipitation affect groundwater recharge, surface runoff and the seasonal availability of water. At the same time, higher temperatures can increase evaporation and water demand.

The consequences extend across a region whose rivers support the livelihoods and economic activities of a substantial part of Asia's population.

The International Centre for Integrated Mountain Development (ICIMOD) estimates that the mountain water systems of the Hindu Kush Himalaya provide freshwater and other ecosystem services to approximately two billion people, including populations living within the mountains and those in downstream river basins. This figure describes the wider geographical importance of these systems. It does not mean that all these people depend directly on glacier meltwater or face the same level of water insecurity.[13]

The distinction between water availability and water security is central to understanding the region's future.

A river basin may continue to receive substantial annual precipitation while experiencing shortages during critical periods. Water may be available in one part of a catchment but difficult to transport to another. Households may live near rivers yet lack access to safe drinking water because of inadequate treatment facilities, pollution or unreliable distribution systems.

These difficulties can intensify when seasonal water patterns become less predictable.

The retreat of glaciers illustrates this problem. Initially, accelerated melting can increase runoff in glacier-fed catchments. As ice reserves diminish, the additional contribution from glacier melt may subsequently decline. The timing of this transition, commonly described as *peak water*, differs between catchments and depends on local climatic and hydrological conditions.

The IPCC has emphasised that the importance of glacier meltwater also depends on distance from the glaciers and on the availability of other sources. Far downstream, rainfall

[13] ICIMOD (2023). Water, Ice, Society, and Ecosystems in the Hindu Kush Himalaya: An Outlook.

and groundwater may dominate total river discharge. Nevertheless, glacier melt can remain valuable during dry periods when other water sources are limited.[14]

Snow cover and groundwater are equally relevant to water security. In many mountain communities, springs provide water for domestic use, livestock and small-scale agriculture. Their reliability depends on precipitation, groundwater storage and, in some catchments, contributions from snow and glacier melt.

Changes in these relationships can affect communities without producing an immediate or obvious decline in annual river discharge.

Research published in September 2026 by Smith and Bookhagen[15] examined discharge deficits in the central Himalaya and their relationship with warming and vegetation change. The study reinforces the need to consider how climate change affects the processes through which precipitation becomes available as river discharge, rather than treating river flow as a simple function of glacier mass alone.

This distinction is also relevant to groundwater. Climate-driven changes may alter the contribution of rainfall, snowmelt and glacier melt to subsurface water storage. A river may maintain its overall flow while becoming increasingly dependent on rainfall, potentially changing its seasonal reliability.

For communities and water managers, such changes can be difficult to address. Existing reservoirs, canals, irrigation systems and municipal water networks have often been designed around historical patterns of water availability. More variable conditions may require changes in storage capacity, allocation rules, infrastructure operation and the coordination of different water users.

The ability to respond is unevenly distributed.

Larger cities and economically stronger regions may have access to engineering expertise, financial resources and alternative water sources. Rural communities and smaller settlements may depend on local springs, seasonal streams or limited groundwater reserves. Where infrastructure is inadequate, even relatively modest changes in water availability can have substantial consequences for households and livelihoods.

Water insecurity also interacts with existing social inequalities. Differences in income, land ownership, access to infrastructure and political influence affect who receives water during shortages. Competition may arise between domestic consumption, irrigation, industry, energy production and ecological requirements.

The consequences therefore depend on decisions about allocation as well as on changes in the physical environment.

A broader assessment of human security in the Hindu Kush Himalayan region, published by UNDP and partner institutions in 2026, examines how climate-related pressures interact

[14] IPCC (2019). Special Report on the Ocean and Cryosphere in a Changing Climate, Chapter 2, FAQ 2.1: How does glacier shrinkage affect river runoff further downhill?
[15] Smith, T., & Bookhagen, B. (2026). Discharge deficits in the Central Himalaya linked to greening and warming. *Scientific Reports*, 16, Article 27373. https://doi.org/10.1038/s41598-026-68997-3

across water, food and energy systems. Its findings underline that vulnerabilities can reinforce one another, particularly where livelihoods depend on several climate-sensitive resources and institutional capacities are limited.[16]

A settlement may remain physically habitable while becoming economically and socially more difficult to sustain. Repeated interruptions in drinking water supply, higher costs for irrigation, unreliable energy production and declining livelihood opportunities can place increasing pressure on households and public institutions.

Communities may respond through improved water storage, changes in consumption, more efficient irrigation, alternative livelihoods or cooperation with neighbouring regions. Migration may form part of these responses, but it is neither inevitable nor equally available to everyone.

Where adaptation remains effective, communities may continue to live in their established locations. Where water insecurity combines with economic decline and limited institutional capacity, temporary movement or permanent relocation may become more attractive or necessary.

The future of settlement therefore depends partly on whether societies can maintain reliable access to water under changing environmental conditions.

Water security is not simply a question of how much water remains in the Himalayas. It concerns the ability to manage changing water resources in ways that sustain human livelihoods, essential infrastructure and equitable access across generations.

2.4 Food Production

Food production in the Hindu Kush Himalayan region and its downstream river basins depends on the interaction of rainfall, snow and glacier melt, groundwater and irrigation infrastructure. Agriculture has developed around seasonal patterns of water availability, particularly the South Asian monsoon. Changes in these patterns can affect crop yields, planting schedules, livestock production and the economic security of farming communities.

The effects of climate change are not limited to a gradual reduction in water supplies. Delayed monsoons, irregular rainfall, prolonged dry periods and intense precipitation can disrupt agricultural production even where total annual rainfall remains relatively stable. Floods may destroy crops and irrigation systems, while droughts can force farmers to reduce cultivation or draw more heavily on groundwater. Rising temperatures also influence crop development and agricultural water demand.

The consequences differ between river basins. In the Indus basin, irrigated agriculture depends heavily on water originating in mountain snow and ice, whereas rainfall plays a greater role in the Ganges and Brahmaputra systems. Agricultural vulnerability therefore

[16] UNDP, ICIMOD, IGES & UNU (2026). Human Security Under Climate Stress in the Hindu Kush Himalaya Region: A Scoping Assessment.

depends on local hydrological conditions, the crops being cultivated and the capacity of farmers to respond to changing water availability.[17]

A study published in *Nature Sustainability* in 2019 quantified the contribution of mountain snow and glacier melt to agriculture in the Indo-Gangetic Plain. It found that up to 60 percent of irrigation withdrawals in the Indus basin during the pre-monsoon season originated from mountain snow and glacier melt. The contribution was lower in the Ganges floodplains but remained relevant during dry periods, including for water-intensive crops such as sugarcane.

The researchers estimated that approximately 129 million farmers in the Indus and Ganges basins depended substantially on snow and glacier melt for their livelihoods. They also calculated that this water contribution was sufficient to produce food crops capable of sustaining a balanced diet for approximately 38 million people. These figures describe the agricultural contribution of mountain meltwater under the conditions examined in the study. They are not projections of future food shortages or displacement.[18]

The relationship between agricultural production and mountain water systems is therefore both seasonal and economic. Farmers depend on water being available when crops need it, while households depend on agricultural production for income and food. Changes in water availability can affect these relationships differently, depending on access to irrigation, land ownership, markets and financial resources.

Adaptation is possible, but its effectiveness varies. Farmers may change sowing dates, adopt less water-intensive crops, improve irrigation efficiency or invest in rainwater harvesting and storage. Changes in agricultural practices can reduce dependence on uncertain water supplies, although they may also require new equipment, knowledge and access to credit.

Crop selection involves economic considerations. Water-intensive crops may remain financially attractive even where water supplies are under pressure. A shift to alternative crops may therefore depend on market conditions, agricultural policy and the availability of reliable information about future water resources. Groundwater extraction can compensate for seasonal shortages, but excessive withdrawals may create further problems where aquifers are replenished slowly.

Food security is also affected by events that interrupt production suddenly.

The flood disaster of 26 August 2026 in Nepal's Bhotekoshi–Trishuli river system provides a recent example. According to an assessment published by the Food and Agriculture Organization of the United Nations (FAO)[19], approximately 1,806 hectares of agricultural land were damaged, including rice paddies and vegetable fields. The assessment estimated

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[17] United Nations Environment Programme (UNEP) / GRID-Arendal (2016). *Agricultural Productivity: Net Production Index*.
See also ICIMOD (2023). *Water, Ice, Society, and Ecosystems in the Hindu Kush Himalaya: An Outlook*. https://doi.org/10.53055/ICIMOD.1028

[18] Biemans, H., et al. (2019). Importance of Snow and Glacier Meltwater for Agriculture on the Indo-Gangetic Plain. Nature Sustainability, 2, 594–601. DOI: 10.1038/s41893-019-0305-3

[19] Food and Agriculture Organization of the United Nations (FAO). (2026). Rasuwa–Bhotekoshi Flood in Nepal: Urgent Call for Assistance. https://www.fao.org/nepal/nepal-rasuwa-bhotekoshi-flood--urgent-call-for-assistance/en

crop production losses of around 7,686 tonnes and reported extensive losses of livestock, fisheries infrastructure and irrigation facilities.

The destruction extended beyond the immediate loss of a harvest. Damaged agricultural land, disrupted transport routes and the loss of productive animals affected the ability of rural households to resume farming and maintain their incomes. The event illustrates how a disaster originating in a mountain environment can produce lasting consequences for food production and rural livelihoods.

Such events do not establish that agriculture will become impossible across the Himalayan river basins. They demonstrate how environmental hazards can interact with existing economic vulnerabilities and create recovery needs that extend well beyond the immediate emergency.

Transhumance and mobile agricultural livelihoods

Agriculture in the Himalayan region also includes forms of production that have never depended exclusively on permanent settlement. One example is *transhumance*, the seasonal movement of livestock and herders between established grazing areas.

Transhumance allows pastoral communities to make use of vegetation and water resources that become available at different elevations during the year. Herds may spend warmer months in mountain pastures and return to lower elevations as temperatures fall. These movements are organised around ecological conditions, customary practices and relationships between communities and grazing territories.

Such systems have developed in different parts of the world, including the Himalayas and European mountain regions. Their continued existence demonstrates that mobility can be compatible with established social relationships, economic activity and collective resource management.[20]

Within the Himalayas, communities such as the Gaddis, Bakarwals and Bhotiyas have developed pastoral livelihoods involving seasonal migration. These practices contribute to household economies and cultural identity while allowing the use of grazing resources across different ecological zones.

The movement of livestock can support the distribution of grazing pressure and nutrients across landscapes. However, its ecological effects depend on herd size, grazing intensity, land conditions and management practices. Pastoral mobility should therefore not automatically be equated with environmental sustainability.

Traditional pastoral systems are also undergoing substantial changes.

A study by Tonk and Kaur, published in January 2026, examined transhumance among the Gaddi community in the Dhauladhar Himalayas of Himachal Pradesh. Based on interviews

[20] Manzano, P. and Casas, R. (2010). Past, Present and Future of Trashumancia in Spain: Nomadism in a Developed Country. Pastoralism, 1(1), pp. 72–90

and other fieldwork involving 80 participants, the researchers identified economic, social and institutional pressures affecting the continuation of pastoral livelihoods.[21]

Among the participating herders, difficulties included limited access to basic services, demanding working conditions, problems obtaining grazing permits and changing expectations among younger generations. The study also described the challenges posed by extreme weather, difficult mountain crossings and interruptions in communication with families.

These findings indicate that the decline of transhumance cannot be attributed to climate change alone. Education, employment opportunities, infrastructure development, land-use regulation and changing social preferences influence whether younger people continue pastoral traditions.

Road construction, for example, may facilitate transport and market access while also altering traditional movement routes. Restrictions on grazing areas may limit established forms of land use. Improved employment opportunities may encourage younger generations to pursue different livelihoods. Such developments can weaken pastoral systems even where grazing resources remain available.

Climate change adds further uncertainty. Changes in snowfall, precipitation and vegetation growth may alter the timing and accessibility of seasonal pastures. More frequent or intense environmental hazards can make mountain crossings dangerous and disrupt established migration schedules.

For communities whose livelihoods depend on seasonal movement, adaptation therefore involves more than securing access to water and grazing land. It also requires institutions that recognise mobility as a legitimate form of economic and social organisation.

Pastoralists may need access to healthcare, education, veterinary services and legal protection while moving between locations. Their livelihoods also depend on arrangements governing access to grazing territories, migration routes and water resources.

These requirements have direct relevance to the questions examined in TEOS 2100.

Traditional transhumance demonstrates that social organisation does not necessarily require continuous residence in a single location. At the same time, the pressures affecting pastoral communities show how institutions organised around fixed territories can restrict mobile livelihoods.

The future of food production in the Himalayan region will depend on the capacity of agricultural and pastoral systems to respond to changing environmental conditions. Some communities may adapt their crops, technologies or production practices while remaining in place. Others may diversify their livelihoods or increase seasonal movement.

[21] Tonk, A., & Kaur, M. (2026). Transhumance in Transition: Socio-economic Shifts among Semi-nomadic Gaddi Tribe of Dhauladhar Himalayas. Pastoralism. DOI: 10.3389/past.2025.15370.

For TEOS 2100, the significance of these developments extends beyond agricultural productivity. Food production is connected to employment, land access, cultural continuity and the relationship between communities and the environments on which they depend.

Where water insecurity and environmental hazards repeatedly undermine these relationships, the economic basis of permanent settlement may weaken. Yet existing mobile agricultural systems also offer evidence that people can organise productive activities and social relationships across different places.

The question is therefore how future institutions can support both settled and mobile forms of agricultural life under changing ecological conditions.

2.5 Energy Generation

Energy generation in the Hindu Kush Himalayan region is closely connected to the availability and management of freshwater. Mountain rivers provide the basis for substantial hydropower production, while thermal power stations downstream also depend on water for cooling and other operational processes.

Climate change affects these energy systems through shifts in seasonal river discharge, changing precipitation patterns and increasing exposure to natural hazards. The consequences vary between locations and technologies. In some catchments, additional glacier melt may initially support higher river flows. Elsewhere, changes in rainfall, prolonged dry periods or sediment transport may reduce the reliability of generation. Over time, the continued loss of glacier ice can alter the availability of meltwater during seasons when other sources are limited.

The significance of these developments extends beyond electricity production. Energy supply supports irrigation, industrial activities, transport, communication and essential public services. Disruptions can therefore affect economic activity and household security across river basins.

Dependence on Himalayan water systems

A 2019 study by The Energy and Resources Institute (TERI) examined the relationship between Himalayan water resources and India's energy security. It estimated that approximately 52 percent of the country's hydropower capacity and 33 percent of its thermal electricity generation capacity depended on water from rivers originating in the Himalayas.[22]

These figures describe the geographical dependence of energy infrastructure on Himalayan river systems at the time of the assessment. They do not mean that these proportions of electricity generation are supplied directly by glacier meltwater.

Hydropower facilities depend on river discharge, hydraulic head and the capacity to regulate water flows. Changes in these conditions may affect generation efficiency and the seasonal

[22] Tayal, S., & Sarkar, S. K. (2019). *Climate change impacts on Himalayan glaciers and implications on energy security of the country*. The Energy and Resources Institute. https://www.teriin.org/sites/default/files/2019-11/cc-impact-himalayan-glacier.pdf

availability of electricity. Thermal power stations face different risks, including insufficient cooling water during droughts and operational disruption during floods.

The relationship between water availability and electricity generation is therefore more complex than a gradual decline in energy output as glaciers retreat.

Reservoirs can store water and help balance seasonal fluctuations, but they are also exposed to sediment accumulation and extreme inflows. Run-of-river hydropower facilities may be more directly affected by short-term changes in river discharge. The technical characteristics and location of individual facilities influence their vulnerability.

Hydropower expansion and transboundary rivers

At the same time that climate change is altering mountain water systems, governments continue to invest in hydropower infrastructure.

One of the largest projects is being developed on the lower reaches of the Yarlung Tsangpo River in Tibet, near the river's Great Bend. Construction was formally launched by the Chinese government on 19 July 2025. The project comprises five cascade hydropower stations and has an estimated investment cost of approximately 1.2 trillion yuan, equivalent to around US$168 billion at the time of the announcement.[23]

The project is intended to generate substantial quantities of low-carbon electricity. Its planned scale would make it one of the world's largest hydropower developments.

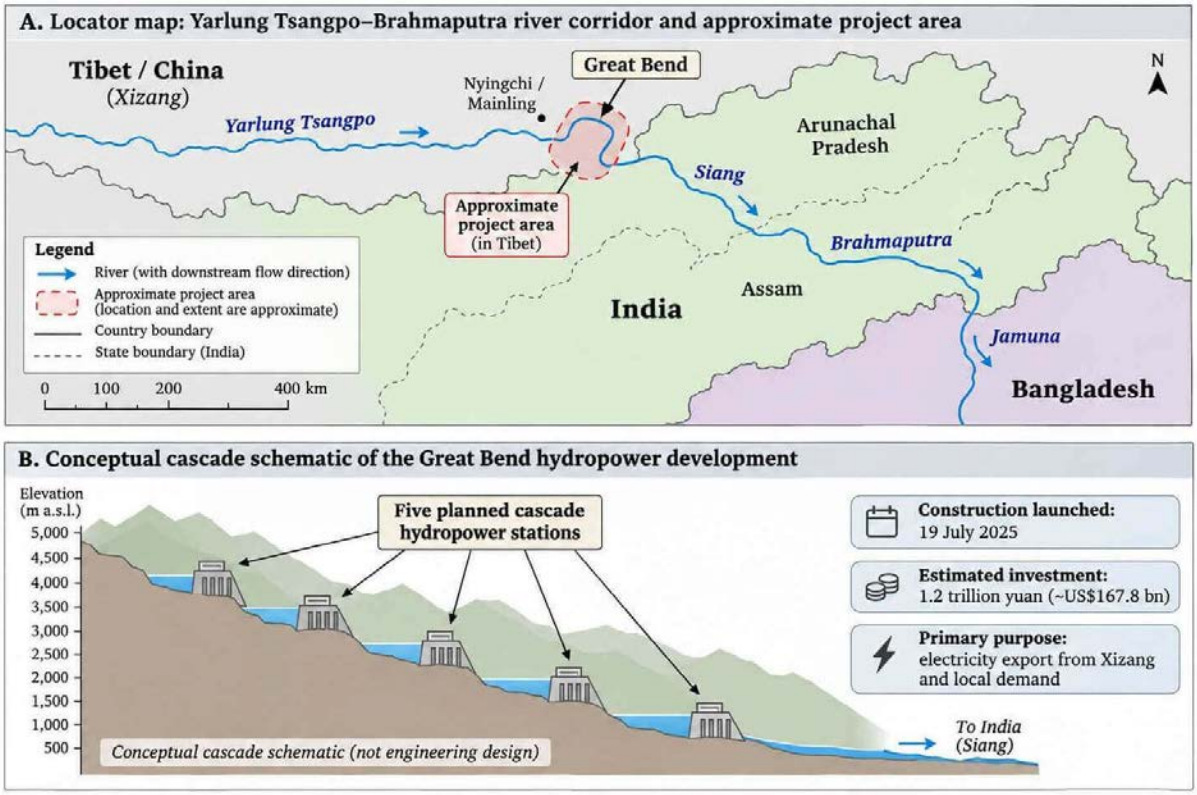
However, its location raises questions about the environmental and political implications of major infrastructure on transboundary rivers.

The Yarlung Tsangpo flows into India, where it becomes the Siang and subsequently the Brahmaputra, before continuing into Bangladesh as part of the Brahmaputra-Jamuna system. Changes in upstream water management can therefore be relevant to downstream communities, ecosystems and infrastructure.

Figure 3: Proposed hydropower development at the Great Bend of the Yarlung Tsangpo River.

The upper panel illustrates the approximate project location and the transboundary river corridor connecting China, India and Bangladesh. The lower panel provides a conceptual representation of the five planned cascade hydropower stations. The schematic does not depict the final engineering design or verified facility locations. Source: Own illustration based on information published by the State Council of the People's Republic of China (19 July 2025) and supplementary geographical sources.

[23] Government of China / Xinhua (19 July 2025). Chinese premier announces construction of Yarlung Zangbo hydropower project.



India and Bangladesh have expressed concerns about the possible consequences of the Chinese project. These include uncertainty about future flow regulation, sediment transport, ecological impacts and the availability of hydrological information.

Chinese authorities have presented the development as a means of expanding renewable energy production while maintaining that downstream water supplies and ecosystems will be protected.[24]

The actual consequences will depend on the engineering design, operating rules and environmental conditions. The construction of a large hydropower complex does not in itself demonstrate that downstream rivers will dry up. Nevertheless, the concentration of infrastructure and decision-making capacity in an upstream section of a transboundary river creates questions of transparency, coordination and the distribution of benefits and risks.

India has also been examining additional hydropower and water-storage infrastructure on the Siang River. Such proposals reflect the interaction between energy development, flood management and concerns about upstream water regulation.

For TEOS 2100, these developments illustrate a broader institutional problem. Energy infrastructure is generally planned and governed within national jurisdictions, while the water systems on which it depends extend across political boundaries.

[24] Reuters (22 July 2025). Why China's neighbours are worried about its new mega-dam project. https://www.reuters.com/world/china/why-chinas-neighbours-are-worried-about-its-new-mega-dam-project-2025-07-22/

Exposure to environmental hazards

Hydropower infrastructure is exposed to hazards originating in high mountain environments.

Glacial lake outburst floods, landslides, rock-and-ice avalanches and intense precipitation can produce sudden increases in river discharge and sediment transport. These events may damage dams, diversion structures, turbines, transmission lines and access roads.

Sediment accumulation can also create longer-term operational problems by reducing reservoir capacity and increasing wear on mechanical equipment.

The IPCC has identified hydropower as an important sector exposed to changing mountain hazards. Its assessment emphasises that the consequences of glacier retreat and altered precipitation depend on local conditions and may require substantial changes in infrastructure management and water allocation.[25]

The disaster of 26 August 2026 in the Nepal–China border region demonstrates these risks.

A major rock-and-ice collapse near Langtang Lirung triggered a destructive sequence of mass movements and flooding through the Bhotekoshi–Trishuli river system. As discussed in Chapter 2.1, the event caused extensive damage to settlements and infrastructure.

Hydropower facilities were among the affected assets. Reports published in September 2026 indicated that more than a dozen hydropower projects had been damaged, including facilities that were already operating and others still under construction. The loss of generating capacity placed additional pressure on Nepal's electricity system.

In a correspondence published in *Nature Sustainability* on 30 September 2026, Schwanghart, Agarwal and Korup examined the vulnerability of Himalayan hydropower infrastructure in the context of this disaster. Their contribution identified the event as part of a wider pattern in which high-mountain hazards create substantial risks for energy facilities and associated investments.[26]

The event does not establish that all hydropower development in the Himalayas is becoming unviable. It demonstrates the importance of considering cascading hazards when infrastructure is designed, financed and operated.

The consequences also extend beyond individual power plants. Damage to access roads, transmission infrastructure or substations can interrupt electricity supply even where generating facilities remain operational. Recovery may require substantial investment and can expose weaknesses in insurance coverage, emergency planning and institutional coordination.

[25] IPCC (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability, Cross-Chapter Paper 5: Mountains.
[26] Schwanghart, W., Agarwal, A., & Korup, O. (2026). Himalayan hazards to high-mountain hydropower. *Nature Sustainability*. Published 30 September 2026. https://doi.org/10.1038/s41893-026-01955-z

Energy security and adaptation

Energy security depends on the capacity of electricity systems to provide reliable and affordable energy despite environmental, technical and political disruptions.

For countries with substantial hydropower resources, the ability to manage seasonal variability and extreme events will influence future generation capacity. Investments in monitoring, storage, transmission infrastructure and maintenance may reduce vulnerability, although no single intervention can eliminate all risks.

Diversification can provide additional flexibility.

Solar and wind power do not require river discharge for electricity generation, although their output is affected by weather conditions. Energy storage, more interconnected electricity networks and flexible demand management can help balance variable generation. These measures involve investment requirements and their own environmental and institutional considerations.

The relationship between water, food and energy systems is also relevant.

The 2026 assessment *Human Security Under Climate Stress in the Hindu Kush Himalaya Region*, prepared by UNDP, ICIMOD, IGES and UNU, examines how climate-related risks interact across these sectors. Its human security perspective highlights that the consequences of environmental change depend on social vulnerability, institutional capacity and access to essential services.[27]

Water used for hydropower may also be required for irrigation, domestic consumption and ecosystem protection. Decisions intended to strengthen electricity production may therefore affect other water users. Conversely, reduced energy availability can make water pumping, irrigation and treatment more difficult.

These interactions become more significant where communities already face economic constraints or limited access to infrastructure.

Improving energy security consequently requires coordination between electricity planning, river basin management and wider development policy. It also requires cooperation across borders where hydrological systems, electricity markets and environmental risks are shared.

For TEOS 2100, energy generation represents another connection between changing environmental conditions and the long-term viability of established settlement patterns.

Reliable electricity supports the functioning of modern settlements. Persistent disruptions can affect water services, employment, communication, healthcare and economic opportunities. Communities may respond through infrastructure adaptation, distributed generation or changes in the organisation of essential services.

[27] UNDP, ICIMOD, IGES, & UNU. (2026). Human Security Under Climate Stress in the Hindu Kush Himalaya Region: A Scoping Assessment. United Nations Development Programme. https://www.undp.org/asia-pacific/publications/human-security-under-climate-stress-hindu-kush-himalaya-region

However, energy insecurity does not automatically lead to migration or the abandonment of settlements. Its consequences depend on the availability of alternatives and the ability of institutions to maintain essential services under changing conditions.

The central issue is therefore not whether Himalayan hydropower will disappear. It is whether energy systems designed around historical river conditions can adapt to greater variability, environmental hazards and competing demands on shared water resources.

2.6 Economic Consequences

The economic consequences of changes in Himalayan water systems extend beyond the immediate effects on agriculture and energy production. River basins connect farms, industrial facilities, settlements, transport networks and markets. When these connections are disrupted, economic losses can spread from the location of an environmental hazard to communities and businesses that are not directly exposed.

Climate-related economic pressures develop through different processes. Gradual changes in water availability, temperature and precipitation can affect agricultural productivity, energy costs and the reliability of infrastructure. Sudden events, including floods, landslides and rock-and-ice avalanches, can destroy productive assets and interrupt essential services.

The distinction matters because the costs of environmental change are not limited to repairing physical damage. Businesses may lose customers when roads become inaccessible. Farmers may be unable to sell their produce. Electricity shortages may interrupt industrial production. Households can lose income while facing higher costs for food, transport and essential services.

These effects can reinforce one another, particularly where livelihoods depend on a small number of economic activities.

Direct damage and wider economic losses

The economic costs of mountain hazards have been documented across several decades.

In a review of the social and economic consequences of mountain cryospheric change, Rasul and Molden (2019) reported estimated losses of up to US$45 billion in the Hindu Kush Himalayan region between 1985 and 2014. The estimate covered damage associated with floods, avalanches, landslides and other climatic stresses.[28]

This historical figure illustrates the substantial economic exposure of mountain regions. It should not, however, be interpreted as the cost of glacier retreat alone. The disasters included in the assessment involved several environmental processes, and the reported losses also reflected patterns of settlement, infrastructure development and economic activity.

Growing economic losses can result from changes in hazard intensity or frequency, but they can also occur because more people and valuable assets are located in exposed areas.

[28] Rasul, G. and Molden, D. (2019). The Global Social and Economic Consequences of Mountain Cryospheric Change. Frontiers in Environmental Science, **7**: 91. DOI: 10.3389/fenvs.2019.00091.

Distinguishing these factors is necessary when assessing the economic implications of climate change.

Direct damage and indirect economic losses also need to be considered separately.

The destruction of a bridge represents a direct loss of infrastructure. Its closure may subsequently prevent workers from reaching their workplaces, interrupt deliveries and reduce access to markets or healthcare. Similarly, damage to a hydropower plant creates repair costs, while the resulting electricity shortage may affect businesses and public services across a much wider area.

Recovery can take considerably longer than the environmental event itself.

The economic consequences of the August 2026 disaster in Nepal

The flood disaster of 26 August 2026 in Nepal provides a recent example of how mountain hazards can propagate through interconnected economic systems.

Originating from a major rock-and-ice collapse near the Nepal–China border, the destructive sequence travelled through the Bhote Koshi and Trishuli river systems. Its consequences affected settlements, transport infrastructure, hydropower facilities and agricultural livelihoods.

A rapid damage assessment published by the World Bank in September 2026 estimated direct economic damage to physical assets at approximately US$1.66 billion. Infrastructure accounted for around 83 percent of the estimated damage, followed by residential and non-residential buildings.

The assessment estimated the replacement value of damaged physical assets. It did not include the full economic consequences of interrupted production, lost income, environmental damage or the wider costs of recovery.

The World Bank's October 2026 Nepal Development Update examined how the disaster could affect the national economy. It identified energy production, transport, trade and tourism as principal channels through which the damage would influence economic activity.

Hydropower was a major concern. Damage to generating facilities and transmission infrastructure reduced the reliability of electricity supply. The affected capacity included facilities in operation and projects under construction, creating both immediate production losses and additional investment requirements.

Transport disruption was similarly significant. More than 55 kilometres of the Galchhi–Rasuwagadhi trade corridor were damaged, including approximately 40 kilometres that were completely washed away. Bridges and road connections were destroyed, interrupting movement along a principal trade route between Nepal and China.

The consequences extended beyond the replacement of roads and bridges. Businesses lost access to suppliers and customers, while damaged transport connections created difficulties for tourism and the movement of agricultural products.

The World Bank also reported damage to more than 200 hotels and restaurants. Access to trekking and pilgrimage destinations was disrupted shortly before Nepal's main autumn tourism season.

The resulting economic pressures affected both formal enterprises and households whose incomes depended on transport, accommodation, trade and related services.

In its October 2026 assessment, the World Bank projected Nepal's real economic growth to slow to 3.7 percent in fiscal year 2027, reflecting the effects of the disaster on industry and services. This was a forecast based on conditions at the time of publication, rather than a measured outcome.

The case demonstrates how a disaster originating in a relatively confined mountain area can produce economic consequences across a much larger territory.[29]

Agricultural livelihoods and household vulnerability

The economic consequences of environmental change are often most immediate for households whose incomes depend on agriculture.

Farmers experience climate-related pressures through crop damage, changes in growing seasons, reduced water reliability and disruptions to livestock production. These effects may reduce household income while increasing expenditure on irrigation, agricultural inputs or the replacement of damaged assets.

Research by Asad and colleagues (2023) examined farmers' perceptions of climate change and adaptation in high-altitude agricultural areas of Pakistan, Nepal and Bhutan. The study surveyed 379 farming households across selected districts and found that respondents reported declining agricultural productivity and revenue, alongside limited access to resources and institutional support.[30]

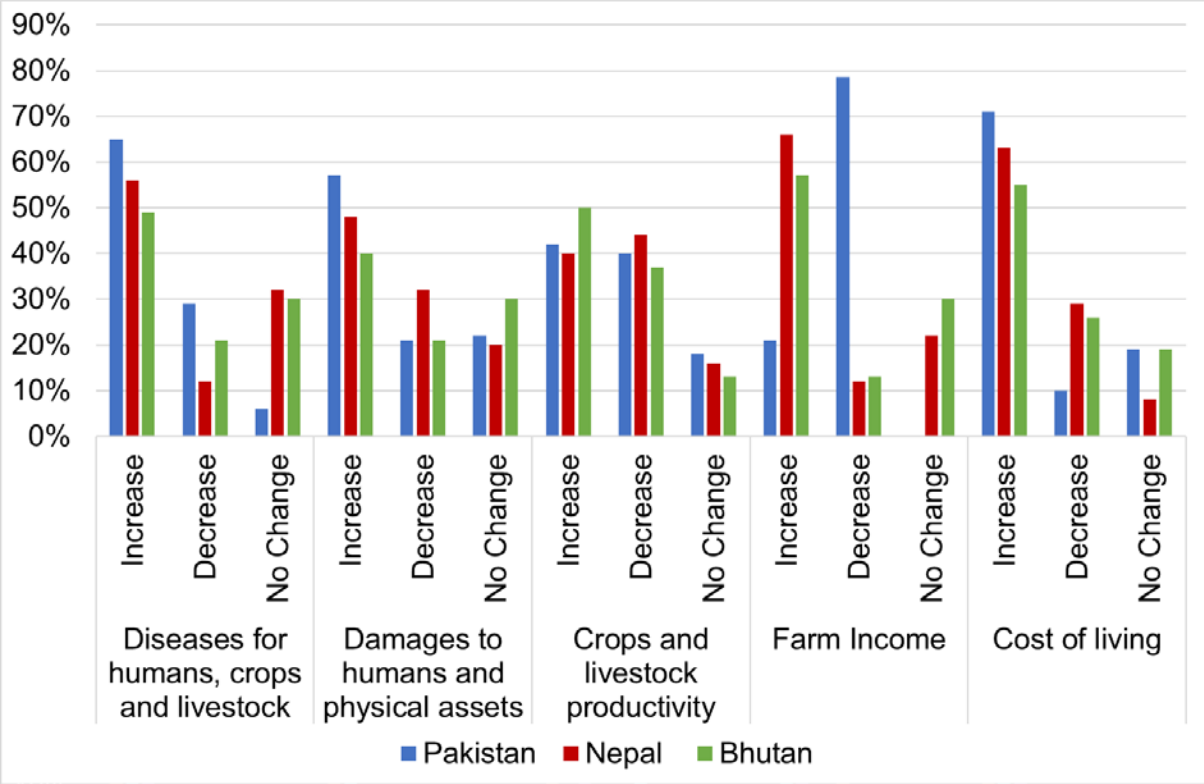
The study provides evidence of how farmers experience environmental and economic pressures in their daily lives. Its results are based on reported perceptions and conditions within the surveyed communities. They should therefore not be treated as directly measured economic losses or as representative estimates for entire countries.

Figure 4: Farmers' reported perceptions of climate-related impacts on agricultural livelihoods in selected study areas of Pakistan, Nepal and Bhutan.

Source: Based on Asad et al. (2023). Results reflect surveyed households rather than nationally representative economic measurements.

[29] World Bank (2026). *Global Rapid Post-Disaster Damage Estimation (GRADE) Report: Rasuwa Flash Flood, Nepal*. Washington, DC: World Bank. Report No. 215321. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099217209292624461
See also World Bank (2026). *Nepal Development Update, October 2026: Building Back Differently for the Future*. Washington, DC: World Bank. http://hdl.handle.net/10986/45723

[30] Asad, S. A., Abid, M., Ahmad, I., Thapa, G., & Dendup, T. (2023). Climate Change Risk Perceptions, Vulnerability, and Adaptation in High Altitude Farming Regions of Hindu Kush Himalaya. APN Science Bulletin, 13(1), 87–101. DOI: 10.30852/sb.2023.2184



Nevertheless, the findings identify constraints that influence the ability of households to respond to environmental change.

Farmers with access to financial resources, reliable infrastructure and agricultural advice may be able to invest in improved irrigation, different crops or alternative sources of income. Households with limited savings or insecure land tenure may find these adjustments more difficult.

Repeated losses can further reduce their capacity to adapt. A household that uses its savings to recover from one flood may have fewer resources available when another event occurs. Borrowing can finance reconstruction or investment, but it may also create additional financial obligations.

The distribution of economic losses is therefore shaped by existing inequalities as well as environmental exposure.

Economic interdependence and public finances

The effects of changing water systems also reach public institutions.

Governments may face higher expenditure on emergency response, reconstruction and infrastructure maintenance. At the same time, reduced economic activity can weaken tax revenues and increase demand for social assistance.

Where several regions depend on the same transport corridors or electricity networks, damage in one location can create costs elsewhere. Reconstruction priorities may also compete with expenditure on education, healthcare and longer-term development.

These pressures can be difficult to manage in regions where infrastructure is already inadequate or where public institutions have limited financial resources.

Economic diversification and regional trade can reduce dependence on individual sectors, but interconnected markets can also transmit disruptions. A damaged transport corridor may affect a wide range of businesses even when their own facilities remain intact.

The economic effects of climate change should consequently be examined through both local vulnerability and wider systems of production, trade and public services.

Implications for settlement and mobility

Economic change influences decisions about where people live and work.

Permanent settlement depends on more than physical access to land and water. Households also need employment opportunities, affordable essential services and a reasonable expectation that they can maintain their livelihoods over time.

Environmental hazards may threaten these conditions suddenly. More gradual changes in agricultural productivity, energy costs or infrastructure reliability can exert pressure over longer periods.

Households respond differently. Some invest in adaptation and remain in place. Others diversify their sources of income, seek temporary employment elsewhere or establish economic connections across several locations.

Migration may provide access to employment and remittances that support relatives who remain in their communities. However, movement also requires resources, social networks and opportunities at potential destinations. The households facing the greatest economic pressure are not necessarily those most able to relocate.

Economic deterioration should therefore not be treated as a direct or universal cause of migration.

For TEOS 2100, the relevant question is how repeated environmental disruptions might alter the economic conditions that sustain established settlement patterns.

The August 2026 disaster in Nepal demonstrates that damage to energy infrastructure and transport networks can affect economic activity well beyond the immediate disaster area. The evidence from agricultural communities shows that slower changes can also place pressure on household livelihoods.

Neither process establishes that large-scale abandonment of settlement is inevitable. Both suggest that the capacity to maintain economic security under changing environmental conditions will influence future choices about residence, employment and mobility.

The implications for human movement are examined in the following chapter.

3. The Age of Displacement

3.1 Internal Migration

Climate-related migration is difficult to define and measure because decisions to move rarely have a single cause. Environmental change interacts with employment, income, family circumstances, political conditions and access to public services. A household may leave an agricultural community following repeated crop losses, but its decision may also reflect limited employment opportunities, rising debt or the prospect of a better livelihood elsewhere.

Climate change can influence these conditions without being the sole or immediate reason for migration. It can also restrict people's ability to move. Understanding climate-related mobility therefore requires attention to both environmental pressures and the social and economic circumstances in which people make decisions.

The distinction between gradual environmental change and sudden disasters is useful, although the two processes often interact.

Gradual change and migration decisions

Slow-onset environmental changes can progressively alter the conditions under which communities sustain their livelihoods. Within the Hindu Kush Himalayan region, these changes include glacier retreat, changing snow cover, rising temperatures, land degradation and shifts in the seasonal availability of water.

The United Nations Framework Convention on Climate Change (UNFCCC) recognises several categories of slow-onset climate-related processes, including glacial retreat, desertification, land and forest degradation and biodiversity loss. Other processes, such as sea-level rise and salinisation, are relevant to the wider downstream regions of South Asia, particularly low-lying coastal areas.[31]

These developments do not necessarily produce immediate population movements. Communities may initially respond by adapting agricultural practices, diversifying income, investing in water infrastructure or relying on financial support from relatives working elsewhere.

Migration becomes one possible response when these adjustments are insufficient, unavailable or less attractive than opportunities in other locations. Mary C. Waters (2024) distinguishes several forms of climate-related mobility, including strategic migration, disaster displacement and managed relocation. Her framework also considers populations that are unable to move despite increasing environmental exposure.[32]

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[31] Cazabat, C. (2021). *Addressing Internal Displacement in the Context of Climate Change*. In *No Matter of Choice: Displacement in a Changing Climate*. Geneva: Internal Displacement Monitoring Centre (IDMC). https://doi.org/10.55363/idmc.suic8369

[32] Waters, M. C. (2025). Preparing for climate migration and integration: a policy and research agenda. *Journal of Ethnic and Migration Studies*, *51*(1), 4-23. https://doi.org/10.1080/1369183X.2024.2438449

Strategic migration describes movement undertaken by individuals or households who seek to reduce their exposure to environmental and economic risks or improve their future opportunities. Such movement may occur before living conditions become intolerable.

A farming household, for example, might send one family member to work in a nearby city while maintaining its home and agricultural activities. Income earned elsewhere can support relatives who remain in the community and help finance adaptation.

The movement may be temporary, seasonal or permanent. It may also involve only part of a household. These arrangements complicate the distinction between settled and mobile populations. People can maintain economic, social and cultural relationships with more than one location without abandoning their original community.

Sudden disasters and internal displacement

Sudden environmental disasters create different conditions for mobility.

Floods, landslides, avalanches and other hazards may require people to leave their homes with little warning. Some households return after the immediate danger has passed. Others remain displaced because their homes, livelihoods or essential infrastructure have been destroyed.

The Internal Displacement Monitoring Centre (IDMC) distinguishes between the number of displacement movements occurring during a given period and the number of people living in displacement at a particular point in time. One person may be displaced more than once, meaning that recorded movements cannot automatically be interpreted as a count of distinct individuals.

This distinction is necessary when comparing displacement statistics across countries and years. In its 2026 Global Report on Internal Displacement, IDMC recorded approximately 29.9 million internal displacement movements associated with disasters worldwide during 2025. The figure was substantially lower than the exceptional total recorded in 2024, illustrating the considerable annual variability of disaster displacement.[33]

In South Asia, disaster-related internal displacements declined to approximately 4.6 million in 2025, following a less severe monsoon season. The figure remained substantial despite the decrease. These statistics describe movements associated with disasters of different kinds. They are not a direct measurement of displacement attributable to anthropogenic climate change, nor do they provide a specific estimate for Himalayan glacier retreat. Their significance lies in the scale of movements that governments and receiving communities must manage under present conditions.

The August 2026 displacement in Nepal

The disaster of 26 August 2026 in Nepal provides a recent example of sudden internal displacement connected to a high-mountain hazard.

[33] IDMC (2026). Global Report on Internal Displacement 2026. https://www.internal-displacement.org/global-report/grid2026/

As discussed in Chapter 2, a major rock-and-ice collapse near the Nepal–China border initiated a destructive sequence of debris flows and flooding. The event caused extensive damage to settlements, transport routes and essential infrastructure. The International Organization for Migration (IOM) undertook emergency displacement tracking in the affected districts.

Its initial assessment, covering 27 - 31 August 2026, recorded 4,288 affected households across 15 assessed sites in the Dhading, Nuwakot and Rasuwa districts. Of these, 2,886 households were identified as displaced.[34] The figures describe households identified through an early operational assessment, rather than the complete number of people displaced across Nepal.

Subsequent IOM assessments examined displacement sites and the needs of affected communities, including access to shelter, essential services and support for vulnerable households. The event demonstrates how a rapidly developing environmental hazard can create immediate movement and longer-term uncertainty about return.

Some displaced households may be able to rebuild in their original communities. Others may face difficulties returning because of damaged infrastructure, continuing hazard exposure or the loss of employment and agricultural assets. The distinction between temporary evacuation and longer-term displacement therefore depends on conditions after the disaster as well as the event itself.

The case also illustrates why disaster displacement cannot automatically be interpreted as permanent migration. The number of households initially displaced does not establish how many will eventually resettle elsewhere.

Existing migration patterns and social networks

Migration research provides useful insights into how people select destinations. Two recurring observations are relevant to climate-related mobility. First, many people move relatively short distances, often within their country of origin. Second, existing relationships with relatives, friends and earlier migrants influence where people go.

The IPCC finds that most observed climate-related migration and displacement occurs within national borders. It also identifies the importance of social, economic and institutional factors in shaping movement.[35] Social networks can provide information about employment, accommodation and public services. They may reduce the costs and uncertainty associated with moving to an unfamiliar location.

A household experiencing declining agricultural income may therefore consider destinations where relatives already live or where community members have previously found work.

[34] International Organization for Migration (IOM), Sep 03 2026. DTM Nepal - Flash Floods - Displacement Snapshot (27-31 August 2026). IOM, Nepal. https://dtm.iom.int/reports/nepal-flash-floods-displacement-snapshot-27-31-august-2026

[35] IPCC (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability, Chapter 7. https://www.ipcc.ch/report/ar6/wg2/

Waters (2024) argues that such networks may influence the development of future migration patterns and the integration of people who move.[36] However, existing networks cannot determine future mobility on their own.

Disasters may disrupt transport routes and communications, while economic conditions in potential destinations may change. Legal restrictions, access to housing, social discrimination and the availability of employment can also influence movement.

Governments can use information about existing migration relationships to improve planning, but projections should be treated as uncertain and should not depend on intrusive surveillance of personal networks.

Migration destinations also require preparation. Communities receiving displaced people may need additional housing, healthcare, schools, water infrastructure and employment opportunities. Planning must account for the needs of both newcomers and existing residents.

Planned relocation and the limits of mobility

In some locations, reducing environmental exposure may eventually require more than adapting existing infrastructure.

Planned relocation involves the organised movement of households or communities away from locations considered too hazardous or difficult to sustain. It can be initiated by public authorities or developed through cooperation between communities and institutions.

Relocation differs from emergency evacuation because it involves decisions about where people will live over the longer term and how their livelihoods, rights and community relationships will be maintained.

It also differs from strategic migration undertaken independently by individuals or households.

International guidance on planned relocation emphasises that moving a community involves far more than providing replacement housing. Decisions must address access to land, employment, education, healthcare and the preservation of cultural and social relationships.[37]

Relocation can reduce exposure to environmental hazards, but poorly designed programmes may create new forms of vulnerability.

Affected communities should participate meaningfully in decisions about whether, when and where relocation occurs. Safeguards are required to prevent coercion, ensure fair

[36] Waters, M. C. (2025). Preparing for climate migration and integration: a policy and research agenda. *Journal of Ethnic and Migration Studies*, *51*(1), 4-23. https://doi.org/10.1080/1369183X.2024.2438449

[37] UNHCR, Brookings Institution & Georgetown University (2015). Guidance on Protecting People from Disasters and Environmental Change through Planned Relocation. https://www.brookings.edu/articles/guidance-on-protecting-people-from-disasters-and-environmental-change-through-planned-relocation/

compensation and provide access to remedies when rights are violated. These considerations are relevant to mountain settlements exposed to repeated floods, unstable slopes or deteriorating access to essential services. Yet relocation is not the only possible response. Investment in local adaptation, improved infrastructure and disaster risk reduction may enable some communities to remain in place.

A further complication is immobility.

People may remain in exposed areas because of strong cultural attachments or because they consider staying preferable to available alternatives. Others may lack the money, physical capacity, legal opportunities or social support needed to move.

The IPCC distinguishes between voluntary and involuntary immobility and identifies situations in which people with limited resources face high environmental exposure without being able to relocate. Any assessment of future mobility must therefore examine who can move, who wishes to remain and who has little meaningful choice.

Implications for TEOS 2100

Internal migration is likely to remain an important component of adaptation to environmental change, but its forms and consequences will vary. Some households may use temporary or seasonal employment to maintain their established homes. Others may move permanently to cities or different agricultural regions. Sudden disasters may cause displacement without necessarily leading to permanent relocation.

Over time, repeated environmental and economic pressures could also contribute to changes in settlement patterns. The significance for TEOS 2100 lies in how institutions respond to these movements. Public services, social protection and political participation are generally organised around territorial jurisdictions and established places of residence. People who move repeatedly or maintain connections with several locations may encounter difficulties accessing rights and services.

A society experiencing greater mobility will therefore need institutions capable of supporting people through changes in residence, employment and community membership. This does not imply that permanent settlement will disappear or that migration will become the preferred response to climate change. It indicates that the distinction between settled and mobile populations may become less adequate for understanding how people organise their lives.

The following section examines the additional questions that arise when movement crosses international borders.

3.2 Cross-Border Migration

While most observed climate-related migration and displacement takes place within national borders, international movement also forms part of the response to environmental and economic pressures. People may cross borders to find employment, join family members, seek protection or recover from the loss of a livelihood.

In the Hindu Kush Himalayan region and its downstream areas, migration across international borders is well established. Some of these movements connect communities that have maintained economic and cultural relationships for generations. Others are shaped by contemporary labour markets, political instability and changing border regulations.

Climate change may influence these movements, but its contribution is difficult to isolate. A farmer who leaves a drought-affected district may also be responding to debt, declining agricultural profitability or employment opportunities in another country. The same environmental pressure may lead one household to migrate while another remains in place.

The IPCC finds that international migration associated with climatic hazards is considerably less common than internal movement. Where international climate-related migration has been observed, it frequently takes place between neighbouring countries with existing migration arrangements or longstanding social ties.[38]

These findings provide a useful starting point for examining cross-border mobility in South Asia. They do not establish that existing migration corridors are predominantly driven by climate change.

Established migration corridors

Migration between Bangladesh and India, Nepal and India, and Afghanistan and Pakistan illustrates the different conditions under which people move across borders. These corridors are influenced by geography and historical relationships, but they operate within different legal and political environments.

Migration from Bangladesh to India has long been associated with economic opportunities, family connections and historical patterns of population movement. Environmental pressures, including flooding, riverbank erosion and salinity intrusion, can affect livelihoods in Bangladesh and influence decisions about migration. However, evidence of environmental stress does not establish that a particular international movement was caused by climate change.

Research on climate-related migration in South Asia identifies the interaction between environmental vulnerability, economic inequality and migration policy as a persistent feature of regional mobility.[39]

Nepal and India provide a different example.

[38] Waters, M. C. (2025). Preparing for climate migration and integration: A policy and research agenda. *Journal of Ethnic and Migration Studies*, 51(1), 4–23. https://doi.org/10.1080/1369183X.2024.2438449
See also IPCC (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Working Group II, Chapter 7: Health, Wellbeing and the Changing Structure of Communities. https://www.ipcc.ch/report/ar6/wg2/chapter/chapter-7/

[39] Sadik, M. S., Samia, M., Noor, B., Raihan, M. S., & Khan, R. M. (2026). Climate change and migration in South Asia: Trends, obstacles, and policy practices. In *Disasters, Climate Change and Sustainability in South Asia*, pp. 187–207. Springer. https://doi.org/10.1007/978-3-032-04750-2_9

The 1950 Treaty of Peace and Friendship established a framework for the movement and residence of citizens across their shared border. This arrangement has supported longstanding patterns of employment, trade and family mobility.

Nepali workers have used access to the Indian labour market to supplement household income and respond to limited employment opportunities at home. Seasonal and circular migration allows some workers to maintain their homes and social relationships in Nepal while earning income in India.

Research published by the International Organization for Migration (IOM) documents the importance of this corridor and the role of established social relationships in facilitating movement. Environmental changes may affect the economic circumstances of households using these routes. Yet the existence of cross-border employment cannot in itself be treated as evidence of climate-induced migration.

The Afghanistan-Pakistan border presents another set of circumstances. Decades of conflict, displacement, labour migration and family relationships have created extensive connections between the two countries. Environmental stresses, including drought and water insecurity, affect livelihoods in Afghanistan. Nevertheless, current cross-border movements are also heavily influenced by security conditions, legal status and government policies concerning Afghan nationals residing in Pakistan.

The distinction between these drivers is essential when interpreting contemporary migration data.

Border governance and human security

Crossing an international border introduces legal and institutional conditions that do not arise in the same form during internal migration. Migrants may require passports, visas, work permits or proof of nationality. Access to employment, healthcare and social protection may depend on their legal status. Even where neighbouring populations have longstanding relationships, border controls can interrupt established patterns of movement.

The Bangladesh-India border illustrates these tensions.

Human rights organisations have documented deaths and injuries associated with border enforcement, as well as concerns about arbitrary detention and expulsions. In June 2026, Human Rights Watch reported cases in which ethnic Bengali residents of India were expelled towards Bangladesh without adequate procedures to establish their nationality or legal status. Some families were left stranded between border authorities.

These developments concern human rights and migration governance. They should not be interpreted as evidence that the affected people were displaced by climate change.[40] They do, however, show the difficulties that people can face when legal status is disputed or when border enforcement operates without effective safeguards. Similar problems arise when

[40] Human Rights Watch (2026). India: Ethnic Bengalis Unlawfully Expelled, 16. Juni 2026. https://www.hrw.org/news/2026/06/16/india-ethnic-bengalis-unlawfully-expelled

migrants depend on informal employment arrangements or have limited access to legal assistance.

Border policies can influence whether migration offers a viable adaptation option. Where movement is legally accessible and workers can obtain employment and essential services, cross-border migration may provide economic security. Where movement is restricted or legal protection is uncertain, it can expose people to exploitation and additional risks.

Forced returns from Pakistan to Afghanistan in 2026

Recent developments along the Afghanistan-Pakistan border illustrate the extent to which migration outcomes can be determined by state policy. Pakistan has implemented measures requiring categories of Afghan nationals without recognised permission to remain to leave the country. These policies have contributed to extensive return movements, including deportations.

According to the UNHCR Afghanistan operational data portal, approximately 721,700 returns from Pakistan to Afghanistan were recorded between 1 January and 24 October 2026.[41] The figures include different categories of return and must not be interpreted as a count of people voluntarily choosing to migrate.

IOM monitoring indicates that fear of arrest and deportation has been a major reason for departure among Afghan nationals affected by these policies. The movements have raised protection concerns, including the circumstances of people returning to areas with limited employment opportunities, inadequate services and continuing humanitarian needs.

This case does not demonstrate climate-induced cross-border migration. Rather, it shows how political decisions can produce large population movements and constrain the choices available to households already facing economic and environmental pressures.

For TEOS 2100, the distinction matters. Future environmental change may increase pressure on livelihoods, but the direction and conditions of migration will remain strongly influenced by state decisions and international protection arrangements.

Remittances and transnational livelihoods

Cross-border migration can also create economic opportunities for migrants and the communities from which they originate. Workers living abroad frequently send part of their earnings to relatives. These remittances can support household consumption, education, healthcare, housing and investment in small businesses. At a wider economic level, remittances can contribute to foreign exchange earnings and help stabilise household incomes during periods of economic uncertainty.

[41] UNHCR & IOM (2026). Afghanistan Situation: Returns and Deportations, Operational Data Portal. Data as of 24 October 2026. https://data.unhcr.org/en/situations/afghanistan

Economic research has examined how migration affects income, labour markets and welfare in both countries of origin and destination. The benefits depend on the characteristics of migration, the costs of moving and the economic opportunities available to migrants.[42]

Nepal provides an example of the importance of remittances.

The World Bank's 2025 Country Economic Memorandum[43] identifies international migration and remittance inflows as major contributors to poverty reduction and household resilience. By 2021, more than seven percent of Nepal's population had migrated abroad, primarily in search of employment. In 2023, remittances represented approximately one quarter of Nepal's gross domestic product. The World Bank attributes a substantial part of Nepal's progress in reducing poverty to these flows.

These figures reflect migration for many reasons, predominantly employment. They should not be presented as the economic consequences of climate-related migration alone. Nevertheless, remittances can influence how households respond to environmental risks. Income earned abroad may help finance irrigation equipment, repair damaged homes or compensate for agricultural losses. Families can therefore use migration to diversify their livelihoods while maintaining their original residence.

This may create households whose economic activities and social relationships extend across national borders. Such arrangements are relevant to the longer-term questions examined in TEOS 2100. They demonstrate that residence, employment and economic security need not be confined to a single territory.

However, remittance dependence also creates vulnerabilities. Employment losses abroad, recruitment costs, exchange-rate changes or restrictive migration policies can reduce household income. Families may become dependent on earnings generated in labour markets over which they have little influence.

Labour rights and the conditions of mobility

The economic benefits of international migration should not obscure the risks faced by migrant workers. Recruitment fees, debt, the withholding of identity documents, unsafe working conditions and restrictions on changing employers can expose workers to exploitation. These risks are not limited to migration from the Himalayan region, but they are relevant to labour corridors connecting South Asia with destination countries in Asia and the Gulf.

International labour standards and guidance developed by the International Labour Organization (ILO) emphasise fair recruitment, access to information, enforceable employment contracts and protection from forced labour. The ability to leave an exploitative employer, obtain legal assistance and access basic services can influence whether migration improves a person's security.

[42] di Giovanni, J., Ortega, F. and Levchenko, A. A. (2015). A Global View of Cross-Border Migration. Journal of the European Economic Association, 13(1): 168–202.
[43] World Bank (2025). Unlocking Nepal's Growth Potential: Nepal Country Economic Memorandum. https://www.worldbank.org/en/country/nepal/publication/unlocking-nepal-s-growth-potential

For people whose migration is partly motivated by environmental pressures, these protections may become increasingly relevant. A household facing repeated agricultural losses may have fewer resources to absorb recruitment debt or periods without earnings. Policy frameworks should therefore address the conditions under which migration occurs, rather than treating movement itself as evidence of successful adaptation. This includes protections for migrants with different legal statuses and mechanisms to resolve disputes concerning wages, contracts and recruitment practices.[44]

Regional cooperation and climate-related mobility

Climate change creates a further reason to examine existing arrangements for cross-border movement. River basins linked to the Hindu Kush Himalaya extend across several national jurisdictions. Their populations are connected through trade, employment and family relationships, while the countries concerned retain different rules governing entry, residence and labour.

Nepal's National Adaptation Plan for 2021–2050 provides a framework for responding to climate risks across public policy. It recognises the need to integrate adaptation into national and subnational planning. However, national adaptation measures cannot independently resolve questions concerning the treatment of people who move across borders.

Cooperation between neighbouring states may be needed to improve disaster preparedness, exchange information, protect workers and facilitate access to assistance in emergencies. Existing migration corridors offer institutional experience on which such arrangements could build. Yet their different legal and political conditions also show that cooperation cannot be assumed.

Agreements concerning labour mobility, documentation, social protection and the recognition of qualifications may become relevant where environmental change affects livelihoods across shared regions. At the same time, policies must protect the rights of people who do not move, including those who remain in exposed areas by choice or because they lack the means to relocate. Cross-border mobility is therefore one potential component of climate adaptation, rather than a universal response to deteriorating environmental conditions.

Implications for TEOS 2100

The significance of cross-border migration for TEOS 2100 lies in the relationship between human mobility and territorially organised institutions.

Current migration patterns already demonstrate that people can maintain livelihoods and family relationships across national boundaries. Remittances, temporary employment and circular migration connect economic activities in different countries. Yet access to rights and services remains strongly dependent on nationality, residence status and the rules of individual states.

[44] International Labour Organization (2019). General Principles and Operational Guidelines for Fair Recruitment and Definition of Recruitment Fees and Related Costs. https://www.ilo.org/publications/general-principles-and-operational-guidelines-fair-recruitment-and

Environmental change may increase the importance of these arrangements for some households, while creating additional restrictions or risks for others. The experience of existing migration corridors offers no basis for assuming that a future decline in Himalayan water reliability will automatically generate large international migration flows. The scale and direction of such movement will depend on economic conditions, adaptation opportunities, political decisions and legal arrangements.

What can be examined is the capacity of institutions to support people whose livelihoods and residences extend across borders. If mobility becomes a more significant feature of life in parts of the region, the ability to maintain access to employment, healthcare, education and social protection across changes in residence may become increasingly consequential.

The next section considers how internal and international migration interact with urbanisation and the changing conditions of life in growing cities.

3.3 Urbanization

Cities play a central role in contemporary migration. They offer employment, education, healthcare and access to services that may be unavailable in smaller settlements. For people whose livelihoods have been affected by environmental change, moving to an urban area can provide opportunities to diversify income and reduce dependence on climate-sensitive activities.

Yet cities are also exposed to environmental hazards. Flooding, heatwaves, water shortages and infrastructure failures can affect established residents and newcomers alike. Where urban growth exceeds the capacity of public institutions to provide housing and essential services, these pressures may become more difficult to manage.

Urbanisation therefore has a dual significance for TEOS 2100. Cities can provide opportunities for adaptation, while their own vulnerability raises questions about how many people they can accommodate safely and under what conditions.

Environmental change and rural-urban migration

Rural-urban migration is driven by several overlapping factors. Employment opportunities, education, family relationships, public services and wider economic changes all influence decisions about residence.

Environmental change can affect these decisions by altering agricultural productivity, access to water and the reliability of rural livelihoods. It may make existing migration routes more attractive or increase the need for households to diversify their income.

The UK Government Office for Science examined these relationships in its 2011 Foresight report, *Migration and Global Environmental Change*. The report found that environmental change often interacts with established migration patterns rather than creating entirely new

ones. It also emphasised that migration can function as an adaptation strategy and that some environmentally vulnerable populations lack the resources needed to move.[45]

A household affected by declining agricultural income may send one member to work in a nearby town while other family members remain in the village. If employment becomes more secure, the arrangement may develop into longer-term urban residence. Other households may continue moving between rural and urban locations according to seasonal work, family obligations or economic circumstances.

Such movements do not necessarily involve the abandonment of rural communities. Migration can help maintain them through remittances, investment and the circulation of knowledge and resources. The distinction between mobility and permanent relocation is therefore relevant to urbanisation as well as to the migration processes discussed in the preceding sections.

Bangladesh provides an example of how environmental pressures can interact with existing migration pathways. Riverbank erosion, flooding and coastal hazards can undermine rural livelihoods, while employment opportunities in cities attract people from different parts of the country. Some households respond through temporary migration or by moving to urban centres. However, these movements cannot be attributed exclusively to climate change. Economic opportunities, social networks and the availability of housing also shape decisions.[46]

Similar relationships may develop in communities connected to Himalayan river systems. Changes in water availability, agricultural production or infrastructure reliability can affect the economic attractiveness of rural areas, while urban employment offers alternative sources of income. The scale of such movement remains uncertain. Existing evidence does not establish that glacier retreat will lead to a uniform or inevitable migration of mountain populations towards major downstream cities.

Urban growth and the capacity of receiving cities

Urbanisation is already transforming South Asia independently of climate-related migration. The United Nations' *World Urbanization Prospects 2025*[47] identifies Central and Southern Asia as a region where substantial urban growth is expected to continue. The report projects that India, Pakistan and Bangladesh will be among the countries contributing significantly to the global increase in city populations through 2050.

[45] Government Office for Science (2011). Migration and Global Environmental Change: Future Challenges and Opportunities. UK Government Foresight Programme. https://www.gov.uk/government/publications/migration-and-global-environmental-change-future-challenges-and-opportunities

[46] Government Office for Science (2011). *Migration and Global Environmental Change: Future Challenges and Opportunities*. UK Government Foresight Programme. https://www.gov.uk/government/publications/migration-and-global-environmental-change-future-challenges-and-opportunities

[47] United Nations (2025). World Urbanization Prospects 2025: Summary of Results. UN DESA/POP/2025/TR/No. 12. https://desapublications.un.org/publications/world-urbanization-prospects-2025-summary-results

The report also shows that urban growth is not confined to large metropolitan areas. Smaller and medium-sized cities account for a substantial share of urban settlement and include some of the world's fastest-growing urban centres. These findings have implications for climate adaptation.

Larger cities may possess extensive transport systems, employment markets and administrative institutions, but they also face complex demands on infrastructure. Smaller cities may provide more accessible destinations for nearby rural populations, while lacking sufficient financial and technical resources to manage rapid growth.

The ability to accommodate additional residents depends on the provision of housing, reliable water and electricity supplies, sanitation, healthcare, education and public transport. Population growth can increase pressure on these systems where investment does not keep pace with demand. However, urban growth can also support economic development and improve the efficiency of service delivery when adequately planned.

The relationship between urbanisation and environmental vulnerability is therefore shaped by public policy, infrastructure investment and the distribution of economic opportunities.

Cities as environmentally exposed settlements

Cities located within Himalayan river basins face environmental pressures of their own. Kathmandu, Dehradun and Delhi illustrate different urban contexts connected to the wider Himalayan region. Their exposure to water insecurity, flooding and other hazards depends on local geography, infrastructure and patterns of development. Mountain and foothill cities may be affected by intense precipitation, slope instability and disrupted transport connections. Downstream urban areas may face seasonal water shortages, river flooding, extreme heat and competing demands for water.

The IPCC's Sixth Assessment Report identifies growing risks in urban areas where climate-related hazards interact with population growth, inadequate infrastructure and social inequality. Urban expansion can increase exposure when construction extends into floodplains, unstable slopes or other hazardous locations. The loss of vegetation and permeable surfaces may also intensify runoff during heavy precipitation.

Water management presents a related challenge. Cities depend on water sources and infrastructure that frequently extend beyond their administrative boundaries. Supplies may originate in distant catchments, while treatment facilities, pumping systems and distribution networks require reliable energy.

Changes in regional hydrology can therefore affect urban water security, although the consequences depend on infrastructure design, groundwater availability, water demand and management decisions. These relationships connect the urban questions examined here to the transformations of river basins described in Chapter 2. Urban centres are not isolated destinations offering protection from environmental change. They are part of larger ecological and economic systems that may themselves be under pressure.

Informal settlements and unequal vulnerability

The consequences of urban growth are distributed unevenly. People arriving in cities may find employment and improve their living conditions. Others may face insecure work, high housing costs or limited access to essential services. Where affordable housing is unavailable, some households settle in informal neighbourhoods or occupy land exposed to flooding, landslides or other hazards.

The IPCC identifies residents of informal settlements as among the urban populations facing high vulnerability to climate-related risks. Inadequate housing, limited drainage, insecure land tenure and restricted access to healthcare or sanitation can increase exposure and constrain recovery after disasters.[48]

However, vulnerability cannot be inferred from migrant status alone.

Some migrants possess financial resources, established networks or access to stable employment. Others may encounter discrimination, difficulties obtaining documentation or restrictions on public services. Long-established urban residents can face similar disadvantages.

The capacity to adapt depends on household resources, legal conditions, social support and the availability of public infrastructure. Urban adaptation measures must therefore account for differences within communities rather than treating migrants as a uniform vulnerable group.

Investments in drainage, safe housing, public health systems and reliable water supplies can reduce risks for both newcomers and existing residents. Planning that excludes informal neighbourhoods may instead reinforce the inequalities that make environmental hazards more damaging.

Urban flooding and the limits of existing infrastructure

Flooding is a major environmental hazard for many cities in South and East Asia. Heavy rainfall, river overflow and insufficient drainage can damage housing, disrupt transport and interrupt economic activity. The consequences may become more severe where urban development increases impermeable surfaces or removes natural areas that absorb and retain water.

The 2011 Foresight report already identified the growing exposure of urban populations in flood-prone areas as a concern for future migration and development. More recent IPCC assessments reinforce the underlying conclusion: urban expansion and climate change can interact to increase flood exposure, particularly where development occurs in hazardous locations and infrastructure is inadequate.[49]

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[48] Sadik, M. S., Samia, M., Noor, B., Raihan, M. S., & Khan, R. M. (2026). Climate change and migration in South Asia: Trends, obstacles, and policy practices. In *Disasters, Climate Change and Sustainability in South Asia*, pp. 187–207. Springer. https://doi.org/10.1007/978-3-032-04750-2_9

[49] IPCC (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability, Chapter 6: Cities, Settlements and Key Infrastructure.

The scale of future risk depends on both environmental conditions and decisions about land use. An increase in the number of people living in flood-prone areas does not necessarily indicate that flooding itself has become more frequent. Exposure may grow because residential and commercial development extends into locations where flooding was already possible. Similarly, a damaging flood cannot automatically be attributed to climate change without an appropriate attribution assessment. These distinctions matter for evaluating urban risk and designing effective adaptation measures.

Drainage systems, flood-resistant infrastructure, early-warning systems and restrictions on construction in highly exposed areas may reduce losses. Nature-based approaches, including the protection of wetlands and urban green spaces, can complement engineered infrastructure. The effectiveness of these measures depends on local conditions, maintenance, funding and the participation of affected communities.

Urbanisation, adaptation and future settlement patterns

For TEOS 2100, the relationship between urbanisation and mobility raises a question that extends beyond population growth. If environmental and economic pressures increase movement towards cities, how will urban institutions provide reliable services while adapting to changing climatic conditions?

In some circumstances, cities may become more important centres of economic opportunity and public service provision. Population concentration can support investment in transport, healthcare and infrastructure. In others, the combined effects of rapid growth, inadequate investment and environmental hazards may place increasing pressure on urban living conditions.

These possibilities are not mutually exclusive. Different neighbourhoods within the same city may experience contrasting developments, while smaller urban centres may offer opportunities unavailable in major metropolitan areas. Migration can also produce more flexible relationships between rural and urban locations. Households may retain property in one place, work in another and depend on social networks extending across several settlements.

Such arrangements already exist. Their future development will depend on employment conditions, transport accessibility, housing markets and institutional rules. The central issue is therefore not whether cities will continue to grow. It is whether urban systems can provide secure and sustainable living conditions while responding to changing patterns of mobility and environmental risk.

A post-settlement perspective does not require the disappearance of cities. It asks whether rights, essential services and economic participation can remain accessible when people maintain connections with several locations or change residence repeatedly. Urbanisation thus represents a further stage in the relationship between environmental change, human mobility and institutional adaptation.

The following section considers the legal and protection questions that arise when people displaced by environmental conditions move beyond their country of origin.

3.4 Climate Refugees

The relationship between climate change and human displacement raises questions that existing international protection frameworks do not fully resolve.

As discussed in the preceding sections, environmental change can influence migration through damage to livelihoods, disruptions to essential services and the destruction of homes and infrastructure. Some people move within their countries, while others cross international borders. These movements do not constitute a single legal category.

The term *climate refugee* is frequently used in public debate to describe people who have been compelled to leave their homes because of climate-related environmental changes. However, it is not a formally recognised legal status under international refugee law. This distinction matters because the rights available to people who move depend partly on the legal circumstances of their displacement, rather than on the severity of the environmental conditions alone.

The scope of the 1951 Refugee Convention

The principal international legal framework for refugee protection is the 1951 Convention relating to the Status of Refugees, together with its 1967 Protocol. Under Article 1A(2), refugee status generally requires a well-founded fear of persecution connected to one or more recognised grounds: race, religion, nationality, membership of a particular social group or political opinion. The person must also be outside their country of nationality or former habitual residence and unable or unwilling to seek that country's protection because of the relevant fear.[50]

The Convention does not identify environmental degradation, water scarcity or climate change as independent grounds for refugee status. A person who crosses a border solely because agricultural conditions have deteriorated or a flood has destroyed their home will therefore not ordinarily qualify as a refugee under the Convention on that basis alone. This does not mean that environmental circumstances are irrelevant to refugee law.

Climate-related pressures can interact with persecution, discrimination and armed conflict. Competition over resources may contribute to violence, while political authorities may withhold assistance from particular communities for discriminatory reasons. Where a person faces persecution connected to one of the recognised Convention grounds, the circumstances surrounding a disaster or environmental crisis may form part of a valid refugee claim.

UNHCR's 2020 legal guidance explains that claims arising in the context of climate change and disasters must be assessed according to the applicable legal criteria. Neither the presence of an environmental disaster nor its absence determines whether international protection is required. The question is whether the individual circumstances establish a recognised need for protection.

Environmental migration and different forms of mobility

[50] UNHCR (1951/1967). Convention relating to the Status of Refugees and Protocol relating to the Status of Refugees. https://digitallibrary.un.org/record/556508?v=pdf

The limited scope of the Refugee Convention has contributed to the development of broader terminology for movements associated with environmental change.

In 2007, the International Organization for Migration (IOM) proposed a working definition of environmental migrants encompassing people who leave their habitual residences because of sudden or gradual environmental changes, whether voluntarily or under compulsion, temporarily or permanently, and within their own countries or across international borders.[51]

The terminology was subsequently developed further in the IOM's *Glossary on Migration*. Environmental migration is generally understood as a broad category of movement associated with adverse environmental changes. Climate migration refers more specifically to movement connected to changes in the environment attributable to climate change.

Other categories describe the circumstances of movement. Disaster displacement involves people who are forced or obliged to leave their homes because of a disaster. Planned relocation concerns organised processes through which people move away from locations exposed to significant risks. These processes may involve internal movement or, under different legal arrangements, movement across borders.

These concepts describe different aspects of human mobility. They are not necessarily mutually exclusive, and they should not be treated as equivalent legal statuses.[52] A household may, for example, initially evacuate during a flood, remain displaced while essential infrastructure is repaired and later choose to relocate permanently for economic reasons. The legal protections available at each stage may differ.

For TEOS 2100, this distinction is important because future patterns of mobility may involve repeated movement, temporary residence and connections to several locations rather than a single permanent change of residence.

Human rights and protection against return

Refugee law is not the only international legal framework relevant to people displaced in the context of environmental change. International human rights law may prevent a state from returning an individual to a country where there is a real risk of serious violations of protected rights. This principle is commonly described as *non-refoulement*. Its application under human rights law is not necessarily limited to people who meet the refugee definition in the 1951 Convention.[53]

The relationship between climate change and non-refoulement was examined in *Teitiota v. New Zealand*, a case decided by the United Nations Human Rights Committee[54]. Ioane Teitiota, a national of Kiribati, argued that environmental deterioration, rising sea levels and

[51] International Organization for Migration (2007). Migration and the Environment. Discussion Note MC/INF/288. Geneva: International Organization for Migration.
[52] International Organization for Migration (2019). Glossary on Migration. International Migration Law No. 34. https://publications.iom.int/books/international-migration-law-ndeg34-glossary-migration
[53] UNHCR (2020). Legal Considerations Regarding Claims for International Protection Made in the Context of the Adverse Effects of Climate Change and Disasters. https://www.refworld.org/policy/legalguidance/unhcr/2020/en/123356
[54] UN Human Rights Committee (2020). Ioane Teitiota v. New Zealand, CCPR/C/127/D/2728/2016. https://digitallibrary.un.org/record/3979204?v=pdf

the resulting pressures on living conditions placed him at risk if he were returned to his country. The Committee concluded that New Zealand had not violated his right to life in the circumstances of his case. However, it recognised that the effects of climate change in a receiving country could, under sufficiently serious conditions, expose individuals to violations of the rights to life or freedom from cruel, inhuman or degrading treatment.

Such circumstances may engage the non-refoulement obligations of a state considering a person's removal. The decision did not establish a general right to asylum for people affected by climate change. It demonstrated that environmental conditions can become relevant to the assessment of existing human rights obligations. The threshold for protection remains demanding and depends on the individual circumstances, the seriousness of the foreseeable harm and the applicable legal standards.

Developing approaches to international protection

Legal scholarship and international organisations have increasingly examined how established protection frameworks can respond to displacement associated with disasters and climate change. Waters (2024)[55] identifies the need to connect migration research with policy planning and integration measures rather than assuming that all environmentally influenced movement requires a single legal response.

A declaration developed by the Refugee Law Initiative in 2024[56] similarly argues that disaster-related circumstances must be considered within the existing rules of refugee and human rights law. It rejects both the automatic recognition and the automatic exclusion of protection claims arising in the context of environmental disasters.

In February 2025, a consortium involving the Center for Gender and Refugee Studies, the Kaldor Centre for International Refugee Law and the University of Essex, with support from UNHCR, published a practical toolkit on international protection in the context of climate change and disasters[57]. The toolkit examines how established legal principles can be applied to individual claims, including situations involving persecution, serious harm and barriers to safe return.

These developments reflect efforts to clarify the application of existing law rather than the creation of a new universal category of climate refugee. Other legal and policy instruments can also be relevant. Regional refugee frameworks in Africa and Latin America contain broader criteria than the 1951 Convention in certain circumstances. Humanitarian admission, temporary protection and residence arrangements may provide alternative responses where people require assistance but do not qualify for refugee status.

[55] Waters, M. C. (2024). Preparing for climate migration and integration: a policy and research agenda. Journal of Ethnic and Migration Studies, 51(1), 4-23.
[56] Refugee Law Initiative (2024). Declaration on International Protection in the Context of Disasters and Climate Change. International Journal of Refugee Law, 36(1–2), 169–175. DOI: 10.1093/ijrl/eeae011.
[57] CGRS, Kaldor Centre & University of Essex (2025). International Protection for People Displaced across Borders in the Context of Climate Change and Disasters: A Practical Toolkit. Mit Unterstützung des UNHCR. https://cgrs.uclawsf.edu/en/our-work/publications/international-protection-people-displaced-across-borders-context-climate

However, the availability and legal consequences of these mechanisms vary between jurisdictions. They do not establish a uniform international right to enter and reside in another country because of climate-related environmental change.

Protection needs in the Hindu Kush Himalayan region

The Hindu Kush Himalayan region illustrates why these legal distinctions matter. Environmental hazards may destroy homes, interrupt essential services and undermine livelihoods. Yet the people affected may have different reasons for moving and different legal relationships with the states through which they travel. Some will remain within their country of origin and require protection and assistance as internally displaced persons. Others may use established employment and family migration routes to seek economic opportunities abroad.

A smaller group may cross borders in circumstances involving persecution, conflict or serious human rights risks. These individuals may qualify for international protection depending on their specific circumstances. The environmental conditions contributing to movement do not by themselves establish which category applies. Existing migration arrangements can therefore become relevant to climate adaptation even where refugee law does not apply.

Access to lawful employment, residence permits, family reunification and essential services may enable households to respond to deteriorating environmental conditions without entering refugee protection procedures. Conversely, restrictive migration systems can reduce available options and leave people exposed to exploitation or unsafe conditions.

International cooperation may be required where environmental hazards affect neighbouring countries or where large movements exceed the administrative capacity of local institutions. However, cooperation must distinguish between migration management, humanitarian assistance and obligations to protect people facing persecution or serious harm. These functions are related but legally different.

Implications for TEOS 2100

The debate over climate refugees raises a question that extends beyond terminology. International law provides substantial protections for recognised refugees and establishes human rights obligations relevant to displacement. Yet people whose livelihoods have become unsustainable because of gradual environmental change do not automatically acquire a right to move to another country or remain there permanently. This creates uncertainty about how future mobility might be governed if environmental pressures contribute to sustained movement across borders.

The implications for TEOS 2100 concern the relationship between territorial sovereignty and the continuity of individual rights. Existing institutions generally determine residence, access to public services and political participation through nationality and territorial jurisdiction. People who move repeatedly or maintain livelihoods across several countries may encounter difficulties navigating these arrangements.

A post-settlement perspective therefore raises questions about the portability of social protection, access to essential services, legal identity and the recognition of rights across different places of residence. These questions do not require a new refugee category as their only possible solution. They may also be addressed through labour mobility agreements, residence arrangements, regional cooperation and the development of human rights protections. Nor does the possibility of increasing climate-related mobility establish that international borders will lose their legal significance.

The future of protection will depend on decisions made by states and international institutions, including how they interpret existing obligations and whether they establish additional mechanisms for people who cannot safely or sustainably remain in their previous locations.

For TEOS 2100, the central question is how legal institutions can preserve protection and access to rights when environmental change places established relationships between people, residence and territory under increasing pressure.

3.5 Border Systems

Environmental hazards originating in the Hindu Kush Himalayan region do not follow political boundaries. Rivers, glaciers, mountain slopes and sediment flows form interconnected systems that extend across national territories. A flood originating in one country may damage settlements, roads and hydropower facilities in another. Changes in river discharge may affect water users far downstream. Hazards developing in remote mountain areas can therefore become matters of international cooperation, even when the initial event is geographically localised.

Borders are relevant to these risks because monitoring, infrastructure planning and emergency response are generally organised through national institutions. The effectiveness of disaster preparedness can depend on whether neighbouring countries share information, coordinate warnings and maintain arrangements for responding to hazards that cross their territories.

Transboundary glacial lake outburst floods

Glacial lake outburst floods are a significant hazard in parts of the Hindu Kush Himalayan region. As glaciers retreat, meltwater can accumulate in lakes contained by ice, moraine deposits or other natural barriers. The sudden failure of these barriers may release large volumes of water and sediment into downstream valleys.

The resulting floods can damage infrastructure and settlements far from the original lake. Their destructive effects depend on the amount of released water, the valley topography, sediment transport and the exposure of communities and infrastructure. Several major river basins cross international borders, creating situations in which the location of a hazardous lake and the areas exposed to flooding fall under different national jurisdictions.

The Gongbatongsha glacial lake outburst of 5 July 2016 provides an example. The event originated in the Poiqu basin in Tibet, China. Following heavy precipitation, a slope failure deposited material into the lake, triggering the failure of its natural dam and the rapid release

of water. The flood travelled downstream into Nepal's Bhotekoshi basin, damaging sections of the Arniko Highway, the Upper Bhotekoshi hydropower facility and nearby buildings.

A scientific reconstruction published in 2022 demonstrated how the flood evolved into a powerful sediment-laden flow as it moved through the valley. The event illustrated that even a relatively small glacial lake can produce substantial damage when conditions allow the flood to mobilise additional material.[58]

It also exposed the practical difficulties of managing environmental hazards across national boundaries. Authorities downstream require timely information about upstream conditions, while observation systems and emergency procedures may be managed by different institutions.

Mapping cross-border exposure

Scientific assessments have identified substantial exposure to glacial lake outburst floods across the Himalayan border regions. A study published in *Nature Climate Change* in 2021 examined the changing distribution of glacial lakes and associated risks across the Third Pole. It found that risks were concentrated in parts of the eastern Himalaya and projected that additional areas could become exposed as glaciers retreat and new lakes develop.

The study emphasised the importance of long-term monitoring and cooperation between neighbouring countries.

Subsequent research by Dubey and colleagues, published in 2024, identified 230 transboundary glacial lakes across the Hindu Kush-Karakoram-Himalaya region. The researchers found that 55 of these lakes had another lake along the potential downstream flow path, creating conditions under which a flood could trigger cascading effects. The China-Nepal and China-India border regions were identified as important areas of potential cross-border exposure.[59]

These findings describe locations where hazards may affect another country. They should not be interpreted as predictions that all the identified lakes will fail. Assessments also differ according to geographical coverage, lake inventories and methods of risk classification. A 2026 study of glacial lakes in the China-Nepal Himalayas identified 2,377 lakes and classified 76 as potentially hazardous, including four in a very-high-risk category and fourteen in a high-risk category.[60]

Such inventories can support the prioritisation of monitoring and mitigation measures. They also need to be updated as glaciers and lakes change. Risk assessment must consider not

[58] Bhatt et al. (2022), Transition of a Small Himalayan Glacier Lake Outburst Flood to a Giant Transborder Flood and Debris Flow. https://pmc.ncbi.nlm.nih.gov/articles/PMC9300610/
[59] Dubey, S., et al. (2024), Transboundary Hazard and Downstream Impact of Glacial Lakes in Hindu-Kush Karakoram Himalayas. Science of the Total Environment, 914, 169758. DOI: 10.1016/j.scitotenv.2023.169758. https://www.sciencedirect.com/science/article/abs/pii/S0048969723083882
[60] Rawlins, L. D., Watson, C. S., Bhambri, R., Khadka, N., and Chand, M. B.: Glacial Lake Observatory (GLO): annual dataset of glacial lakes in Nepal and transboundary catchments (2017–2024), Earth Syst. Sci. Data, 18, 5143–5165, https://doi.org/10.5194/essd-18-5143-2026, 2026.https://essd.copernicus.org/articles/18/5143/2026/

only the likelihood of a lake outburst but also the people and infrastructure that could be affected. Transport corridors, bridges and hydropower facilities are often located in narrow valleys where floodwaters and debris flows may be concentrated. Damage to these assets can interrupt communication, electricity supply and trade between countries.

The 2026 Gyirong-Rasuwa disaster

The events of 26 August 2026 demonstrated the limitations of disaster preparedness focused primarily on known glacial lakes. A major rock-and-ice collapse on the northern flank of Langtang Lirung triggered a rapidly moving sequence of avalanches, debris flows and flooding in the Nepal-China border region. The destructive surge travelled through the Lhende Khola valley and affected the Gyirong-Rasuwagadhi border corridor before continuing downstream through the Bhotekoshi–Trishuli river system.

Unlike the Gongbatongsha event of 2016, the 2026 disaster did not originate from the failure of a conventional glacial lake. According to a preliminary synthesis published by the International Centre for Integrated Mountain Development (ICIMOD) in October 2026, approximately 132 million cubic metres of rock and glacier ice detached from the mountain.[61] Satellite radar observations had detected substantial deformation of the unstable slope in the weeks preceding the collapse.

The destructive surge reached the border corridor within approximately seven minutes of the main collapse. Public SMS alerts were issued only after the corridor had already been affected. The disaster caused severe loss of life and extensive destruction in both Nepal and China. The precise mechanisms of the initial failure remain under scientific investigation. The contribution of anthropogenic climate change to this individual event has not been established.

Nevertheless, the disaster provides evidence of a gap between the monitoring of high-mountain hazards and the capacity to deliver actionable warnings to downstream communities. It also illustrates why a warning system organised exclusively around rainfall measurements, river levels or identified glacial lakes may be insufficient. Rock-slope instability, avalanches and temporary river blockages can produce destructive events with little warning. Their effects may extend across borders even where the initiating processes occur in remote and largely uninhabited areas.

From monitoring to actionable warnings

Effective transboundary disaster management requires more than the exchange of scientific observations. Monitoring systems can combine satellite measurements, hydrological sensors, seismic observations, weather information and local knowledge. The appropriate combination depends on the type of hazard and the physical characteristics of a catchment.

However, detecting a dangerous change is only one stage of an early-warning system. Information must be interpreted, communicated to responsible institutions and translated into warnings that affected communities can understand and act upon. This sequence can be

[61] ICIMOD (2026): Understanding the Gyirong–Rasuwa Disaster of 26 August 2026: A Preliminary Synthesis, veröffentlicht am 13. Oktober 2026 https://lib.icimod.org/records/qdvc1-tc123

difficult where data originate in one country and the threatened communities are located in another. Different administrative procedures, communication systems and responsibilities may delay the exchange of information.

Cross-border cooperation therefore needs to address operational questions: which institutions observe a hazard, who is authorised to issue warnings, how information reaches neighbouring authorities and what actions communities should take when a warning is received. Early-warning systems also require testing, maintenance and arrangements for communication when conventional networks fail.

For hazards capable of travelling through narrow valleys within minutes, warning time may be extremely limited. Advance planning, public awareness, safe evacuation routes and the identification of particularly exposed locations remain necessary even when monitoring technology improves.

Regional cooperation after the 2026 disaster

The Gyirong-Rasuwa disaster prompted a regional discussion about the governance of high-mountain hazards. From 15 to 17 September 2026, ICIMOD, Nepal's National Disaster Risk Reduction and Management Authority and the Embassy of Switzerland convened a meeting in Kathmandu involving governments, researchers and development partners.

The discussions produced the *Kathmandu 10 Action Points*, published on 25 September 2026.[62] The recommendations called for improved monitoring of high-risk mountain areas, stronger regional coordination and faster communication of information relevant to disaster response. Among the proposed measures were inventories of multi-hazard hotspots, expanded satellite-based monitoring, regional technical cooperation and a shared data portal.

The recommendations also emphasised the need to move from exchanging raw observations towards providing information that can directly support decisions. This is a significant distinction. Hydrological measurements or satellite observations are useful only if institutions can interpret them and respond within the available time. The recommendations further addressed emergency response capacity, financing and the recovery of affected communities, including the social and economic consequences of displacement. They represent a regional agenda for improving preparedness rather than evidence that all proposed measures have already been implemented.

China also participated in the September discussions. According to its Ministry of Foreign Affairs, Chinese authorities had provided hydrometeorological information and emergency assistance following the August disaster and expressed support for stronger cross-border monitoring and warning systems. These developments indicate that practical cooperation is possible even where wider geopolitical relationships remain complex. They do not establish that information-sharing arrangements are already sufficient or that future emergencies will be managed effectively.

[62] ICIMOD (2026), Kathmandu 10 Action Points. https://www.icimod.org/press-release/rasuwa-gyirong-floods-prompt-global-call-for-stronger-action-on-cascading-mountain-risks/

Lessons from Afghanistan and Tajikistan

Cooperation between Afghanistan and Tajikistan provides a further example of institutional responses to shared mountain and river risks. The two countries share sections of the Panj and Amu Darya river systems, whose headwaters are influenced by glaciers and high-mountain hydrology.

Lake Sarez in Tajikistan has long attracted international attention because of the potential consequences of a failure of the natural dam that contains it. The lake formed in 1911 when an earthquake triggered a landslide that blocked the Murghab River. It is not a glacial lake. Nevertheless, the possible consequences of a sudden release of water make it relevant to the wider management of mountain hazards.

Earlier assessments have suggested that a catastrophic dam failure could threaten populations in several downstream countries. Figures of up to five million potentially exposed people have appeared in risk studies, but they describe a severe hypothetical scenario rather than an expected outcome. Monitoring and risk-reduction measures have been developed to address this threat.

The institutional experience extends beyond Lake Sarez. Afghanistan and Tajikistan established arrangements for hydrological data exchange in 2014. In September 2020, the two governments signed a memorandum of understanding on environmental protection, covering climate adaptation, biodiversity conservation, water-quality monitoring and the exchange of environmental information. The agreement also included provisions concerning notification of potential transboundary environmental impacts.

The United Nations Environment Programme supported the development of these arrangements and related technical cooperation.[63] This experience demonstrates how countries can establish mechanisms for sharing environmental information across borders. However, the effectiveness and continuity of such mechanisms depend on political circumstances, institutional resources and implementation. It should not be assumed that an agreement alone guarantees operational cooperation during an emergency.

Borders, sovereignty and shared responsibility

The Himalayan region includes borders with significant political and strategic sensitivity. China, India, Nepal and other regional states have different interests concerning water management, infrastructure development and access to environmental data. Restrictions on access to border areas can complicate scientific fieldwork, the installation of monitoring equipment and the maintenance of early-warning systems.

At the same time, environmental hazards create shared risks that cannot be managed effectively by downstream countries alone. This does not remove the importance of sovereignty. States retain responsibility for public safety, infrastructure and the administration of their territories. Cooperation requires agreements that respect these

[63] UNEP (2020): Afghanistan and Tajikistan Step Up Environmental Cooperation https://www.unep.org/en/news-and-stories/press-release/afghanistan-and-tajikistan-step-environmental-cooperation

responsibilities while recognising the physical connections between upstream and downstream areas.

Technical collaboration can provide a practical starting point. Shared observations, compatible warning protocols and regular communication between agencies may improve preparedness without requiring agreement on every wider political issue.

3.6 Security Implications

Climate change is increasingly considered within national and international security policy. Its consequences can affect access to water, food and energy, damage critical infrastructure and place additional pressure on public institutions. These developments may influence relations between states, particularly where environmental systems and economic activities extend across national boundaries.

However, climate change should not be understood as an independent or inevitable cause of armed conflict. Its security implications depend on existing political relationships, economic conditions, institutional capacities and the ways in which governments respond to environmental pressures. For the Hindu Kush Himalayan region, this distinction is essential. Several major river systems cross international borders, linking upstream water management to downstream agriculture, energy production and settlements.

The resulting interdependence creates opportunities for cooperation as well as potential sources of disagreement.

Climate change and international security

Traditional concepts of national security have focused heavily on territorial control, military capabilities and threats originating from other states. Environmental change introduces risks that do not fit easily within this framework. Droughts, floods and changes in water availability can undermine economic production and essential services without involving hostile action by another country. Damage to infrastructure may affect several jurisdictions simultaneously, while the consequences of environmental disruption can extend through trade networks and migration systems.

Research in international relations has therefore examined how climate change affects the conditions under which states exercise sovereignty and provide security. Sending, Øverland and Hornburg (2019) identify climate change as an issue that requires international relations research to consider changing forms of interdependence, authority and political responsibility.[64]

Their approach provides a useful starting point for TEOS 2100 because environmental change raises questions about the ability of territorially organised institutions to manage risks that extend beyond their borders. Nevertheless, the physical consequences of climate change do not automatically weaken state sovereignty or eliminate territorial jurisdiction.

[64] Sending, O. J., Øverland, I., & Hornburg, T. B. (2020). Climate Change and International Relations: A Five-Pronged Research Agenda. Journal of International Affairs, 73(1), 183 ff.

States continue to exercise authority over land, infrastructure and natural resources. International law provides frameworks for managing shared systems and establishing obligations between governments. The security question concerns how effectively these institutions respond when environmental conditions become more variable and when the consequences of decisions extend across national boundaries.

Climate change as a risk multiplier

Climate change is frequently described in security policy as a threat multiplier. The term suggests that environmental pressures can intensify existing vulnerabilities, including economic inequality, political marginalisation, dependence on climate-sensitive livelihoods and weak institutional capacity. It does not establish that climatic changes necessarily produce violence.

The IPCC's Sixth Assessment Report identifies an association between climate variability and some forms of conflict, with more consistent evidence for low-intensity organised violence than for major armed conflicts. The relationship is comparatively weak when assessed alongside other socioeconomic drivers and depends heavily on local circumstances. The IPCC also concludes that available evidence is insufficient to attribute armed conflict directly to climate change.[65] These findings are relevant to the Hindu Kush Himalayan region.

Changes in river discharge may affect irrigation and hydropower operations, but the political consequences depend on how water is allocated, which institutions manage infrastructure and whether mechanisms for resolving disputes remain effective. A decline in water reliability may create economic pressure without producing interstate confrontation. Conversely, disagreements over water infrastructure may occur even when total water availability remains relatively stable. Environmental risks and political decisions must therefore be examined separately before their interaction can be assessed.

The Indus Waters Treaty

The Indus River system provides one of the most significant examples of transboundary water governance in South Asia. Following the partition of British India in 1947, the river system became a central issue in relations between India and Pakistan. The Indus Waters Treaty, signed on 19 September 1960 after negotiations facilitated by the World Bank, established a framework for allocating water use and resolving disputes.

The treaty principally allocates the waters of the three eastern rivers, Ravi, Beas and Sutlej, to India. The three western rivers, Indus, Jhelum and Chenab, are principally allocated to Pakistan, while India retains specified rights for domestic use, certain agricultural activities and hydropower generation subject to treaty conditions. The agreement also established the

[65] IPCC (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability, Chapter 16: Key Risks across Sectors and Regions.

Permanent Indus Commission and procedures for exchanging information and addressing disagreements.[66]

The treaty did not eliminate political tensions between the countries. It nevertheless provided a framework for managing water-related questions through established rules and institutions. Hydropower development has been a recurring source of disagreement. Pakistan has raised concerns about the design and operation of Indian hydropower facilities on the western rivers. India maintains that its projects are compatible with the uses permitted under the treaty.

These disputes involve technical questions about infrastructure design and water regulation, as well as competing interpretations of treaty provisions. The Kishenganga and Ratle hydropower projects have been central to international proceedings concerning the interpretation and application of the agreement.

The treaty dispute of 2025-2026

Relations concerning the Indus Waters Treaty deteriorated after the terrorist attack at Pahalgam in Indian-administered Kashmir in April 2025. On 23 April 2025, India announced that it was placing the treaty in abeyance. The decision formed part of a wider diplomatic response to the attack and reflected India's position that cooperation under the treaty could not continue under the prevailing security conditions. Pakistan rejected India's position and maintained that the treaty remained legally binding.

The disagreement subsequently became the subject of further proceedings before the Court of Arbitration constituted under the treaty, with the Permanent Court of Arbitration serving as its secretariat. On 31 August 2026, the Court of Arbitration issued an award concerning the treaty's status.[67] The tribunal concluded that India's decision to place the agreement in abeyance did not constitute a legally valid suspension or termination. It held that the Indus Waters Treaty remained in force and that India continued to be bound by its obligations. In a separate order issued on the same date, the tribunal prescribed interim measures concerning construction at the Ratle Hydroelectric Plant while related technical questions remained under consideration.

India rejected both decisions. Its Ministry of External Affairs maintained that the tribunal had been improperly constituted and lacked jurisdiction. India stated that it did not recognise the tribunal's decisions and that its position concerning the treaty's abeyance remained unchanged.

The conflicting positions illustrate the difficulty of maintaining international water governance when the parties disagree about the authority of dispute-resolution institutions. The tribunal's legal findings must be distinguished from their practical implementation. The existence of an

[66] World Bank (1960). Indus Waters Treaty 1960. https://documents1.worldbank.org/curated/en/127721589378651773/pdf/Announcement-of-Indus-Water-Treaty-Signed-on-September-19-1960.pdf

[67] Permanent Court of Arbitration (2026). Award on the Status of the Indus Waters Treaty in Respect of India's Decision on Abeyance, 31 August 2026 https://pca-cpa.org/en/cases/284/

award does not by itself establish that cooperation has resumed or that the dispute has been resolved.

The events also demonstrate that the current dispute cannot be attributed primarily to Himalayan glacier retreat. Its immediate political context concerns security relations between India and Pakistan, while longstanding disagreements over hydropower infrastructure form another part of the dispute. Climate change may alter future hydrological conditions within the Indus basin, but it is not necessary to explain the political decisions that led to the current disagreement.

Water security, infrastructure and strategic dependence

The Indus dispute illustrates a broader feature of transboundary river systems. Upstream and downstream countries may have different priorities concerning irrigation, electricity generation, flood management and environmental protection. Infrastructure decisions in one jurisdiction can affect expectations and operating conditions in another. Such relationships create strategic dependence, but they do not automatically give upstream states unlimited control over downstream water supplies.

The capacity to regulate river discharge depends on infrastructure design, storage volumes, seasonal hydrology and the contribution of tributaries downstream. For example, the construction of a hydropower facility does not necessarily imply that an upstream country can permanently prevent water from reaching downstream users. Nevertheless, uncertainty about operating rules, emergency releases and the exchange of hydrological data can affect relations between states.

As discussed in Chapter 2.5, China's major hydropower development on the lower Yarlung Tsangpo has raised concerns in India and Bangladesh about potential downstream effects. These concerns include river regulation, sediment transport, ecosystem impacts and the availability of information about upstream operations. The consequences of the project remain dependent on its technical design and future operation.

It would therefore be premature to present the development as evidence of an unavoidable interstate conflict over water. The project does, however, demonstrate how major infrastructure investments can become strategically significant within transboundary river systems.

Disaster risks and security cooperation

Environmental security also concerns hazards that develop independently of deliberate water management. The 26 August 2026 Gyirong-Rasuwa disaster demonstrated how a rapidly developing high-mountain event can affect communities and infrastructure across national borders. Its consequences included damage to transport connections and hydropower facilities, with wider implications for economic activity and the provision of essential services.

As discussed in Chapter 3.5, the event exposed limitations in existing systems for monitoring mountain hazards and communicating warnings between institutions. These shortcomings

have security implications because the protection of populations and critical infrastructure depends on the availability of timely information and coordinated emergency procedures.

The subsequent Kathmandu 10 Action Points proposed stronger regional monitoring, technical cooperation and information-sharing arrangements. Such measures do not remove political disagreements between neighbouring states. They can, however, create practical areas of cooperation based on shared exposure to environmental hazards. The distinction between military security and human security is relevant here.

Protecting territorial borders remains a responsibility of states. Yet effective protection of people and infrastructure may also require cooperation across those borders. A government may have limited capacity to identify an upstream hazard developing in another country. Without established communication channels, communities may receive too little warning to respond effectively. Environmental security therefore involves both national preparedness and the reliability of transboundary institutions.

Implications for TEOS 2100

The security consequences of Himalayan environmental change are likely to depend on the interaction between physical risks and political institutions. Changes in water availability may affect agriculture, energy production and economic security. Disasters may damage infrastructure and disrupt essential services. Migration may introduce additional questions concerning legal status and access to protection.

These pressures can occur within existing political tensions, but they do not determine how governments will respond. International cooperation, technological adaptation and effective dispute-resolution mechanisms may reduce risks. Conversely, mistrust, institutional breakdown and the politicisation of shared resources may complicate adaptation.

The Indus Waters Treaty illustrates both possibilities. For more than six decades, it has provided a framework for allocating river use and addressing disagreements between India and Pakistan. The dispute of 2025-2026 demonstrates how that framework can become contested during a wider political crisis.

The implications for TEOS 2100 extend beyond the Indus basin. If environmental conditions become less predictable over the coming decades, states may face increasing demands to coordinate infrastructure, information and emergency response across borders. At the same time, established institutions may remain organised primarily around national jurisdictions and territorial control.

This creates a governance question rather than a predetermined security outcome. The long-term challenge is whether existing institutions can maintain cooperation and protect populations when the environmental systems on which societies depend extend beyond the territories those institutions govern.

For TEOS 2100, the prospect of changing settlement patterns and greater human mobility adds another dimension to this question. Security may increasingly involve ensuring continuity of essential services, legal protection and economic participation across movement and changing residence. Such developments would not make territorial sovereignty irrelevant. They would require states to consider how territorially organised

responsibilities can coexist with forms of environmental and human interdependence that are less closely tied to fixed locations.

The following chapter examines the circumstances under which these pressures could affect the long-term viability of settlement itself.

4. The End of Settlement

4.1 Limits of Settlement

Permanent settlement depends on the continued availability of conditions that allow people to sustain their lives in a particular location. These conditions include access to water and food, opportunities to earn a living, functioning infrastructure, public services and institutions capable of providing security and maintaining social relations. Environmental change can weaken these conditions without making a place physically uninhabitable.

A settlement may continue to have sufficient water for domestic use while agricultural production becomes increasingly unreliable. A community may retain its homes and public buildings while repeated floods damage transport connections and reduce access to employment. In other situations, environmental hazards may create risks to life that cannot be reduced sufficiently through available measures. These circumstances raise the question of when adaptation can preserve a settlement and when maintaining established patterns of residence becomes increasingly difficult.

For TEOS 2100, the *limits of settlement* refer to the conditions under which a community can continue to support permanent residence without exposing its inhabitants to risks or losses they consider unacceptable. This is not a fixed physical threshold. The viability of a settlement depends on environmental conditions, but also on economic resources, infrastructure, institutional arrangements and the choices available to its inhabitants. Different groups within the same community may experience these conditions differently.

The gradual weakening of settlement viability should therefore not be confused with an inevitable progression towards abandonment.

Adaptation and the distinction between soft and hard limits

The Intergovernmental Panel on Climate Change distinguishes between soft and hard limits to adaptation. Soft limits arise when adaptation options are not currently available or feasible because of constraints such as insufficient financial resources, inadequate institutions, limited technical capacity or unequal access to support. Such limits may be overcome if these constraints change. Hard limits are reached when no additional adaptive actions can prevent intolerable risks to the objectives or needs of the affected system.[68]

In human settlements, the distinction is significant because the inability to adapt under existing circumstances does not necessarily mean that continued habitation is physically impossible. A community facing unreliable water supplies may lack the resources to expand storage infrastructure or improve distribution networks. These financial and institutional constraints can create a soft adaptation limit. Where resources and technology are available, the community may be able to maintain essential services. Where they are not, households may experience the situation as an effective limit to remaining in place.

[68] IPCC (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability, Chapter 16: Key Risks across Sectors and Regions.

The IPCC identifies increasing risks of adaptation limits in water security, agricultural production and human health as global temperatures rise. It also emphasises that acceptable levels of risk depend on social values and the circumstances of affected populations. Adaptation limits are therefore not determined solely by climate variables. They also reflect what communities seek to preserve, which changes they consider acceptable and the resources available to pursue those objectives.

McLeman's six thresholds of climate-related migration

Robert McLeman (2018) proposed a framework for examining thresholds in the relationship between environmental change, adaptation and migration. The framework identifies six types of transition through which environmental pressures may alter livelihood strategies and patterns of human mobility. The first three concern adaptation within existing settlements.

The **first threshold** occurs when environmental change makes an adaptation response necessary. Existing practices no longer provide an adequate response to changing conditions, and households or institutions begin to modify their activities. For a farming community experiencing greater seasonal water variability, this might involve changing planting schedules, introducing more efficient irrigation or modifying water-storage practices.

The **second threshold** is reached when previously adopted measures become ineffective or insufficient. An irrigation system designed for historical river flows may no longer provide water at the required times. Farmers may have to consider alternative methods or invest in more substantial infrastructure. This does not necessarily mean that adaptation as a whole has failed. It indicates that an existing strategy no longer meets its objectives.

The **third threshold** involves more fundamental changes in land use, livelihoods or the relationship between a community and its environment. Agricultural households may diversify into non-agricultural employment. Land formerly used for water-intensive crops may be converted to other purposes. Local economies may become less dependent on activities that require predictable seasonal water supplies. Such transformations may allow residents to remain in their communities, although the economic and cultural character of settlement can change substantially.

The remaining three thresholds concern changes in migration behaviour.

The **fourth threshold** occurs when adaptation within the existing location is no longer considered sufficient and migration becomes an increasingly viable response. Some households may relocate, while others send individual members to work elsewhere. Seasonal movement may become more frequent or longer in duration.

The **fifth threshold** concerns non-linear changes in migration rates. An environmental shock or the accumulation of economic pressures may produce a sudden increase in movement. Such a change need not be proportional to the environmental deterioration that preceded it. The destruction of a major transport connection, for example, might interrupt access to employment and services across several settlements, leading to a rapid change in household decisions.

The **sixth threshold** describes a situation in which migration rates cease to change non-linearly and establish a more persistent pattern. Movement may continue at an elevated but

relatively stable rate, or migration behaviour may become incorporated into established economic and social arrangements. These thresholds provide a conceptual framework for examining possible changes in adaptation and mobility. They do not constitute a universal sequence through which all communities must pass.[69]

Why settlement transitions are not necessarily linear

The six-threshold model helps explain how environmental pressures can lead to changes in migration behaviour. However, more recent research indicates that mobility decisions may follow different pathways. Some households migrate before local adaptation measures have failed. They may seek employment elsewhere to finance improvements at home or reduce their dependence on a single source of income. Others remain even when living conditions deteriorate substantially. Their decisions may reflect cultural attachments, a preference to stay or limited access to the financial and social resources required for relocation.

Migration can therefore occur before an adaptation limit is reached, while immobility can persist after local conditions have become difficult to sustain. Research on sequential migration decision-making distinguishes between adaptive movement undertaken while households retain options and distress migration that occurs when coping resources have been exhausted. These patterns demonstrate that mobility is not simply the final stage of failed adaptation.

It can be part of the adaptation process from an early stage, and it can help maintain existing settlements rather than replace them. The relationship between environmental pressures and migration is also affected by conditions in potential destination areas. Households may be unwilling or unable to move if employment is uncertain, housing is unaffordable or established social networks are absent. As a result, worsening environmental conditions do not always produce greater migration.

A study published in September 2026 by Petrova and colleagues examined relationships between climate extremes and net migration across subnational regions worldwide. The researchers found that migration responses differed according to hazard type, income level, previous migration patterns and the timing and repetition of environmental events. Flooding was associated with reductions in net migration over several years, while drought-related associations varied more strongly according to income and local migration conditions.

Repeated drought exposure was associated with reduced migrant inflows in some areas that had previously attracted population. The results indicate that environmental stress may influence both the decision to leave a place and the capacity of other locations to receive newcomers.

The analysis identifies statistical associations rather than proving a direct causal relationship between individual climatic events and migration decisions. Its findings nevertheless provide

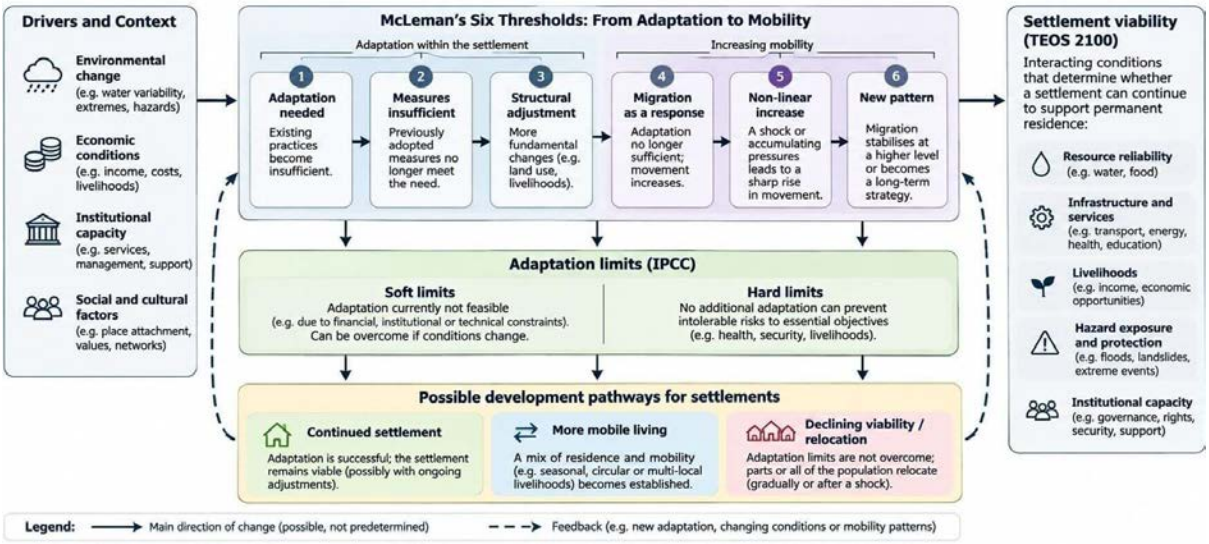
[69] McLeman, R. (2018). Thresholds in Climate Migration. Population and Environment, 39, 319–338. DOI: 10.1007/s11111-017-0290-2.

additional evidence against treating settlement abandonment as an automatic response to environmental deterioration.[70]

Figure 5: Adaptation Limits, Mobility and Settlement Viability

Conceptual framework combining McLeman's (2018) six thresholds of climate-related adaptation and migration with the IPCC's distinction between soft and hard adaptation limits. The framework illustrates how environmental change interacts with economic conditions, institutional capacity and social factors to influence settlement viability. Three possible development pathways are distinguished: continued settlement through adaptation, more mobile or multi-local living arrangements, and declining settlement viability potentially leading to relocation. These pathways are neither mutually exclusive nor necessarily sequential. Feedback mechanisms allow conditions and responses to change over time. The five dimensions of settlement viability and the three development pathways represent an analytical extension developed for TEOS 2100 rather than an empirical prediction of future settlement outcomes.

Source: Own conceptual representation based on McLeman (2018), IPCC (2022), and the analytical framework developed in TEOS 2100.



Settlement viability as a multidimensional condition

For TEOS 2100, the concept of settlement limits needs to extend beyond the presence or absence of particular environmental resources. A settlement can remain physically accessible while the conditions supporting everyday life become increasingly difficult to maintain.

[70] Petrova, K., Zantout, K., Zimmermann, S., et al. (2026). Compound and Heterogeneous Relationships between Climate Extremes and Global Net Migration. Nature Climate Change, 16, 1162–1169. DOI: 10.1038/s41558-026-02752-4.

Water availability is one example. Domestic water supplies may remain sufficient, but irrigation costs may rise and reduce the profitability of agriculture. Hydropower production may become less predictable, affecting businesses and public services. Repeated damage to roads or bridges may weaken access to markets. These changes can accumulate without producing a single identifiable moment at which settlement becomes impossible.

They may also affect different groups unequally. Households with financial resources can invest in adaptation, obtain alternative water supplies or maintain economic connections elsewhere. Those with fewer resources may face a narrowing range of choices. Public investment can extend the viability of settlements through infrastructure improvements, disaster risk reduction and the provision of essential services.

However, decisions about adaptation also involve trade-offs. A large infrastructure project may protect one community while changing water availability or environmental conditions elsewhere. Maintaining a settlement through increasingly expensive engineering measures may also require public resources that could be used for other purposes.

The limits of settlement are therefore partly political and economic. They concern the distribution of resources and the objectives that public institutions seek to protect. For the purposes of this report, settlement viability can be assessed through several interconnected conditions:

- The reliability of essential resources, including safe water and food.
- The capacity of infrastructure and public services to function under environmental stress.
- The availability of livelihoods sufficient to support households and local economic activity.
- The level of exposure to hazards and the effectiveness of protective measures.
- The capacity of institutions to maintain rights, security and collective decision-making.

These dimensions are proposed here as an analytical framework for TEOS 2100, informed by the preceding chapters. They are not presented as an established five-indicator scientific index. Changes in one dimension can influence the others. A loss of agricultural income may reduce household resources for adaptation. Damage to electricity infrastructure may interrupt water treatment and distribution. Declining public revenue may make infrastructure maintenance more difficult. The interaction between these conditions can create cumulative pressures even where individual problems might be manageable.

Limits, choices and unequal mobility

The decision to remain in a settlement or move elsewhere cannot be reduced to environmental exposure alone. People may place substantial value on land, family relationships, cultural heritage and connections to a particular place. Remaining may be a deliberate and meaningful choice, even where environmental risks are increasing.

At the same time, the ability to remain safely depends on access to resources and institutional support. Some households may be able to adapt through private investment or

diversified income. Others may rely on public infrastructure and assistance. Where such support is unavailable, people may face risks they cannot reasonably reduce.

Movement is subject to similar inequalities. Relocation requires access to housing, employment, transport and social networks. International movement may also depend on legal permission to enter and reside in another country. People with fewer resources may therefore be unable to leave, even when they wish to do so.

This creates a distinction between the environmental limits of a location and the practical choices available to its inhabitants. A settlement may lose population without becoming uninhabitable. Conversely, a community may remain populated despite living conditions that expose residents to substantial risks. Population decline alone is therefore an insufficient indicator of settlement failure.

The same applies to increasing migration rates. Movement may indicate environmental pressure, but it may also reflect improved employment opportunities, educational mobility or the expansion of transport and communication networks. Assessing settlement viability requires examining the circumstances under which people remain or move.

Implications for the 2100 foresight horizon

The six-threshold framework offers a way to examine how changing environmental conditions could influence settlement patterns over time. For TEOS 2100, however, it is used as an exploratory framework rather than a predictive model. The report does not assume that every community affected by Himalayan water change will progress through all six thresholds. Nor does it assign fixed dates, population figures or climate conditions to particular stages.

Different settlements may experience different combinations of environmental, economic and institutional pressures. Some may maintain permanent residence through substantial adaptation. Others may become increasingly dependent on seasonal labour migration or economic activities distributed across several locations. In more severe circumstances, repeated disruption to infrastructure, livelihoods and essential services may contribute to permanent relocation or the gradual decline of particular settlements.

These possibilities can coexist within the same river basin. The long-term significance of environmental change therefore lies partly in the diversity of settlement responses it may produce. A future society might contain cities that continue to grow, rural communities that remain viable through adaptation, settlements that lose population and households whose lives extend across several locations.

The emergence of more mobile living arrangements would not necessarily mean that permanent settlement had ceased to exist. It could instead indicate a changing relationship between residence, economic activity and the institutions through which people obtain rights and essential services.

This distinction informs the concept of *Post-Settlement Civilisation* explored later in the report. The concept does not describe the disappearance of settlement as a physical form. It examines whether social and institutional arrangements may need to become less

dependent on permanent residence in one location. The limits of settlement are therefore also limits of existing institutional models.

Where water, livelihoods and people become less reliably connected to fixed locations, public institutions may need to provide services and protection across movement and changing residence.[71] The next section considers how such changes might interact with population distribution and the capacity of areas receiving additional residents.

4.2 Saturation of Habitable Regions

Climate change may progressively alter the geographical distribution of viable human settlements. Water scarcity, declining agricultural productivity, extreme heat, repeated flooding and the deterioration of essential infrastructure can make established places of residence increasingly difficult to sustain. Where adaptation is insufficient or no longer feasible, some settlements may lose the capacity to support their existing populations. People affected by these conditions may seek opportunities in other locations, including regions that continue to offer more reliable access to water, employment and essential services.

This creates a central question for TEOS 2100: what happens when the geographical space capable of sustaining permanent settlement becomes more restricted, while the population requiring access to that space remains substantial?

The consequences may extend beyond the regions directly affected by environmental deterioration. Population movements can increase demand for housing, water, food, employment and public services in receiving regions. These locations may themselves be exposed to climate-related pressures, creating additional difficulties for maintaining acceptable living conditions. The resulting interaction between declining settlement viability in some places and increasing demands elsewhere forms the basis of the concept examined in this section.

For TEOS 2100, *saturation of habitable regions* describes a possible condition in which the demands placed on a settlement or receiving region exceed its capacity to provide acceptable living conditions. Saturation is not equivalent to population density. It refers to the relationship between population needs and the resources, services and institutions available to meet them. The concept is used here as an analytical framework for examining possible future developments, rather than as a fixed demographic threshold or a prediction of global population distribution.

Changing patterns of habitability

Climate change affects human habitability through several environmental processes. Rising temperatures and more frequent extreme heat events can threaten health and reduce labour productivity. Changes in precipitation may increase exposure to droughts or flooding. Sea-

[71] Brianna Castro, Becoming a Climate Migrant: Climate Change and Sequential Migration Decision-Making, *Social Problems*, Volume 73, Issue 3, July 2026, Pages 841–858, https://doi.org/10.1093/socpro/spaf027

level rise can affect low-lying coastal settlements, while changes in snow and glacier systems can alter water availability and increase certain mountain hazards.

The geographical distribution of these pressures varies considerably. Some regions may face combinations of risks that are increasingly difficult to manage. Others may remain habitable through adaptation or experience changes that do not substantially reduce their capacity to support settlement. The IPCC has concluded that some currently densely populated areas may become unsafe or uninhabitable as climate change progresses, particularly under higher-emissions scenarios. It also emphasises that future migration patterns depend on socioeconomic development, adaptation capacity and public policy.[72]

Human habitability is therefore not determined by climate alone. Access to infrastructure, healthcare, secure housing and reliable public services can substantially influence whether people can continue to live in environmentally exposed locations. Technological and institutional adaptation may extend the viability of some settlements. In other cases, the costs, limitations or unequal availability of adaptation may make continued residence increasingly difficult.

These developments suggest that the geographical distribution of viable settlements may change over time. The extent of such changes cannot be established through climate projections alone. It depends on how environmental pressures interact with economic development, infrastructure investment and institutional capacities. For TEOS 2100, the relevant question is how these interactions might affect the space available for sustaining permanent settlement and the distribution of populations within it.

The contraction of viable settlement space

A central hypothesis of TEOS 2100 is that the progressive loss of settlement viability in environmentally exposed regions could reduce the geographical space in which permanent human settlement can be sustained under prevailing social, economic and technological conditions. This does not require large parts of the Earth's surface to become physically uninhabitable. A region may remain accessible and capable of supporting human life while losing the economic, infrastructural or institutional conditions necessary to sustain its existing population.

If water insecurity, declining agricultural productivity and repeated environmental hazards make continued residence increasingly difficult, some inhabitants may relocate to regions where living conditions remain more favourable. The resulting population redistribution would create additional demands on the receiving regions. Housing, water supplies, agricultural production, employment opportunities and public services would need to support both existing residents and newcomers.

At the same time, these receiving regions may experience environmental pressures of their own. This creates the possibility of a cumulative process: as some settlements lose viability, population pressure increases elsewhere, while the capacity of receiving regions to accommodate additional residents may itself become constrained. Under such conditions,

[72] IPCC (2022): Climate Change 2022: Impacts, Adaptation and Vulnerability, Technical Summary, Chapter TS.C.7.

the effective geographical space available for viable settlement could contract even without a corresponding reduction in the amount of land that is physically habitable.

The extent of this contraction cannot be determined from current evidence. It will depend on the progression of environmental change, the effectiveness of adaptation, demographic developments and the capacity of institutions to maintain essential services. Nevertheless, the relationship between declining settlement viability in some locations and growing demands on others represents a plausible mechanism for investigating future population distribution.

The process is not necessarily irreversible. Improvements in infrastructure, changes in economic activity or new approaches to resource management may restore or extend the viability of some settlements. Population decline may also reduce pressure on resources in certain areas. The geographical space available for settlement should therefore be understood as dynamic, shaped by environmental conditions and by human decisions.

For TEOS 2100, the potential *contraction of viable settlement space* provides a basis for examining whether conventional models of permanent settlement can remain sufficient under conditions of increasing environmental pressure and human mobility.

Population redistribution and receiving regions

When people move away from locations facing environmental and economic pressures, they may settle in places where employment, housing or family connections are available. These destinations are not necessarily the areas with the lowest environmental risk. Existing cities, transport networks and labour markets strongly influence migration choices. People may therefore move towards locations that already face high population density, infrastructure constraints or exposure to climatic hazards.

Migration can also take place between rural regions or smaller settlements. The World Bank's *Groundswell* analysis, published in 2021, examined possible patterns of internal climate migration under different climate and development scenarios.[73] Its modelling suggested that up to 216 million people across six world regions could become internal climate migrants by 2050 under the more severe scenarios considered. The study estimated a potential figure of approximately 40 million for South Asia. These figures are conditional modelling results, not forecasts of actual population movements. They do not represent people displaced exclusively by Himalayan glacier retreat or establish the number of people who will move by 2100.

The study also found that stronger climate action and inclusive development could substantially reduce projected migration. Its significance for TEOS 2100 lies in the possibility that environmental change could contribute to emerging areas of population loss and population gain. Such redistribution could place additional demands on receiving regions, but the consequences would depend on their ability to respond.

Where settlements lose population, some demands on local resources may decline. However, falling population numbers can also weaken local economies and reduce the

[73] World Bank (2021): Groundswell Part 2: Acting on Internal Climate Migration https://openknowledge.worldbank.org/entities/publication/2c9150df-52c3-58ed-9075-d78ea56c3267

financial basis for maintaining infrastructure and public services. Receiving regions may experience the opposite pressures, with additional demand for resources and services accompanied by opportunities for economic growth. The consequences of population redistribution therefore need to be considered in both areas of origin and destination.

The capacity of receiving settlements

The ability of a settlement to accommodate additional residents involves several interconnected systems. Housing is a principal requirement. Population growth can increase demand for land, construction materials and affordable accommodation. Where housing supply does not respond, costs may rise and more households may be pushed into insecure or overcrowded conditions. Water and sanitation systems face related demands.

Additional residents require reliable drinking water, wastewater treatment and adequate drainage. The effects of population growth depend on available water resources, infrastructure capacity and management. Energy systems must provide electricity for domestic consumption, businesses and public services. Transport infrastructure needs to accommodate changes in commuting and freight movement. Education and healthcare provision may also require expansion. These demands can create financial and administrative pressures, particularly in settlements with limited public resources.

However, population growth can also increase economic activity, strengthen local labour markets and support investment in infrastructure. A growing population does not necessarily reduce the quality of life. The outcome depends on whether institutions can coordinate the provision of housing, services and economic opportunities. For TEOS 2100, saturation should therefore be understood as a condition that may emerge when the capacity to provide essential services fails to keep pace with changing needs. It is not an inevitable consequence of migration.

The interaction between climate exposure and population growth

Receiving regions may themselves be exposed to climate-related environmental pressures. This creates an additional difficulty for future settlement planning. A city may offer employment and established infrastructure while facing increasing heat stress, seasonal water shortages or flood exposure. New residents may benefit from its economic opportunities even as the city requires substantial adaptation investment.

The relationship between these pressures is illustrated by the World Bank's 2026 report *A Livable Future: Protecting Jobs and Growth from Extreme Heat in South Asia's Cities*. The report estimates that extreme heat already causes productivity losses equivalent to approximately 31 million full-time jobs annually across South Asia. It also projects that the region will need to accommodate approximately 280 million additional people of working age by 2050, many of whom will seek employment in urban labour markets.[74]

Under the climatic scenarios examined, approximately 520 million people could experience at least one month of dangerous heat annually by 2070. These figures concern South Asia

[74] World Bank (2026): A Livable Future: Protecting Jobs and Growth from Extreme Heat in South Asia's Cities https://www.worldbank.org/en/region/sar/publication/a-livable-future-protecting-jobs-and-growth-from-extreme-heat-in-south-asia-s-cities

as defined in the World Bank assessment. They are not projections of migration from Himalayan regions. Nevertheless, they illustrate the interaction between urban growth, changing environmental conditions and the capacity of economies to provide employment.

Cities receiving additional population may need to expand their infrastructure while adapting existing buildings, transport systems and workplaces to higher temperatures. Such demands can create trade-offs in public investment, particularly where local authorities have limited resources. The ability to maintain acceptable living conditions depends on the effectiveness of these investments and on how the resulting benefits are distributed. For receiving regions, the problem may therefore involve two simultaneous developments: increasing population demands and a changing environmental capacity to meet them.

If these trends reinforce one another, the pressure on settlement systems may grow faster than population numbers alone would suggest.

Saturation as a relative condition

A region's capacity to support population cannot be expressed through a universal number of inhabitants per square kilometre. High population density may be compatible with reliable services, economic opportunities and effective environmental management. Conversely, low-density settlements may experience severe difficulties where water supplies are unreliable, transport connections are inadequate or access to essential services is limited.

Saturation is therefore relative to the conditions of a particular location. For TEOS 2100, it can be examined through the same five dimensions of settlement viability introduced in Chapter 4.1: resource reliability, infrastructure and services, livelihoods, hazard exposure and protection, and institutional capacity.

Population growth can influence each dimension. Additional demand for water may expose weaknesses in supply systems. Economic expansion may create employment but also increase pressure on transport networks. More extensive construction may reduce floodwater retention where urban development is poorly managed. Institutional capacity affects whether these developments are anticipated and addressed.

The dimensions can also reinforce one another. Inadequate housing may expose more residents to floods or extreme heat. Limited access to reliable transport can restrict employment opportunities. Higher infrastructure costs may reduce the resources available for maintaining public services. These interactions may create a condition in which additional population places increasing pressure on systems that are already operating near their practical limits.

However, the same population growth may become manageable if infrastructure, governance and economic opportunities improve. The distinction between pressure and saturation is therefore important. Pressure describes growing demands. Saturation describes a failure, under prevailing conditions, to meet those demands at an acceptable level. It should not be treated as a permanent or irreversible state.

Unequal exposure and the distribution of costs

The consequences of settlement pressure are not distributed evenly. Households with greater financial resources may obtain secure housing, access reliable services and adapt to environmental hazards. Lower-income households may face higher relative housing costs, insecure employment and limited access to infrastructure. New arrivals can experience additional difficulties where they lack local social networks, legal documentation or knowledge of available services.

Yet these conditions should not be attributed to migrant status alone. Established residents may experience similar vulnerabilities. Competition for affordable housing or employment can affect several groups simultaneously, while discrimination and unequal resource allocation may reinforce existing disadvantages. The interaction between environmental change and population redistribution therefore raises questions of social justice.

Farbotko, Thornton, Mayrhofer and Hermann (2022) examine the relationship between climate mobility, rights and justice through several case studies. Their research demonstrates that the interests and experiences of people who move, people who remain and communities receiving newcomers cannot be reduced to a single understanding of climate justice.[75] The authors emphasise the importance of geographical, cultural and political circumstances in determining whether mobility-related policies are considered fair or effective.

For receiving regions, these considerations affect decisions about housing, infrastructure investment and access to essential services. Policies that improve conditions for one group while excluding another may intensify social tensions. Inclusive planning can instead reduce vulnerabilities shared by established residents and newcomers. The question of saturation is therefore also a question of how institutions distribute access to resources and opportunities.

Mobility as adaptation rather than displacement alone

Climate-related mobility can serve different purposes. Some people leave because a disaster has made their homes temporarily unsafe. Others move to diversify income or seek more reliable employment. Planned relocation may be considered where environmental hazards make continued residence increasingly difficult. Mobility can also help households maintain their original communities. Employment in another region may generate remittances that finance agricultural adaptation, housing improvements or education for family members who remain.

Such patterns demonstrate that migration does not necessarily produce a complete separation between a place of origin and a destination. Farbotko and colleagues (2022) argue that the relationship between mobility and climate justice requires attention to the choices available to affected people. Support for adaptation within existing settlements is insufficient where people cannot safely remain. Equally, migration arrangements that expose workers to exploitation cannot automatically be regarded as successful adaptation. Policies

[75] Farbotko, C., Thornton, F., Mayrhofer, M., & Hermann, E. (2022). Climate Mobilities, Rights and Justice: Complexities and Particularities. Frontiers in Climate, 4, 1026486. https://doi.org/10.3389/fclim.2022.1026486

should therefore recognise both the right of people to pursue mobility and the interests of those who wish to remain.[76]

These considerations become relevant when receiving regions experience increasing demands on their own resources and institutions. Mobility may reduce environmental exposure for some households while transferring part of the demand for housing, infrastructure and services to another location. Whether this leads to improved human security depends on conditions in both places.

Implications for TEOS 2100

The potential contraction of viable settlement space raises questions about the capacity of existing institutions to respond to changing geographical patterns of residence. If some locations progressively lose their ability to sustain permanent settlement, people may increasingly depend on regions that continue to offer more favourable conditions. The resulting population redistribution could intensify demands on receiving regions, particularly where those regions face environmental pressures of their own.

This cumulative process is a central hypothesis of TEOS 2100. It does not imply that all environmentally exposed settlements will be abandoned or that the world will inevitably be divided into uninhabitable territories and overcrowded safe zones. Instead, it identifies a plausible relationship between declining settlement viability, population redistribution and the capacity of receiving regions to maintain acceptable living conditions.

Public infrastructure and service provision are generally planned according to expected population sizes, land use and patterns of residence. When these assumptions change, institutions may need to respond to more variable demand. Some regions may experience gradual population growth. Others may receive sudden arrivals following disasters. Still others may support people who maintain residences or economic relationships across several locations. These possibilities raise questions about the flexibility of housing systems, service provision and political participation.

A post-settlement perspective introduces a further possibility. If households increasingly distribute their activities across several locations, some public services and economic arrangements may need to become less dependent on permanent residence in one jurisdiction. This does not eliminate the need for housing, water infrastructure or local government. It raises the question of whether institutions can support people whose residence and livelihoods are more variable than those assumed by conventional settlement planning.

The concept of *saturation of habitable regions* therefore helps connect environmental change to the institutional consequences of population redistribution. The contraction of viable settlement space is treated as a possible long-term development, not a predetermined condition of the year 2100. Its occurrence and extent will depend on environmental change,

[76] Farbotko, C., Thornton, F., Mayrhofer, M., & Hermann, E. (2022). Climate mobilities, rights and justice: Complexities and particularities. *Frontiers in Climate*, 4, Article 1026486. https://doi.org/10.3389/fclim.2022.1026486

demographic developments, the capacity for adaptation and the decisions made by societies and their institutions.

For TEOS 2100, the central question is whether established models of permanent settlement can accommodate these interacting pressures or whether new forms of spatial organisation, mobility and service provision may become necessary. The following section examines how changing resource availability and competing demands could influence these developments.

4.3 Resource Competition

Competition over essential resources is already a feature of economic, social and political relations in the Hindu Kush Himalayan region. Water, land, food and energy are distributed unevenly, while competing demands from agriculture, households, industry and electricity generation must be reconciled within existing environmental and institutional constraints. Climate change adds pressure to these relationships by altering resource availability and increasing uncertainty about future conditions.

For TEOS 2100, the possibility that some settlements will lose viability introduces another dimension. If people leave environmentally deteriorating areas and relocate to more favourable regions, demands on resources and public services may become increasingly concentrated in particular locations.

The resulting competition would not be confined to relations between states or economic sectors. It could also affect relations between established communities and incoming populations, particularly where access to housing, land, employment and essential services is already contested.

The central hypothesis is that existing resource competition may intensify as environmental pressures and population redistribution interact. This does not imply an inevitable progression towards violence. It suggests that the ability to allocate resources fairly and resolve competing claims may become an increasingly consequential condition of settlement viability.

The scale of resource dependence

The Hindu Kush Himalayan region is connected to the lives and livelihoods of an estimated 3 to 3.3 billion people through its major river systems, associated agricultural production, resource flows and wider economic relationships. This broader population estimate includes people who benefit from food produced in the river basins. It should be distinguished from the approximately 1.9 billion people living within the major river basins themselves.

The International Centre for Integrated Mountain Development (ICIMOD) has documented the importance of the region for downstream water supply and agricultural production, including the contribution of its river basins to food consumed by more than three billion people.[77] Not all these people depend directly on glacier meltwater. Snowmelt, glacier melt, precipitation, groundwater and stored water contribute differently to individual river systems,

[77] International Centre for Integrated Mountain Development (ICIMOD) (2020). The Hindu Kush Himalayan Monitoring and Assessment Programme (HIMAP): Assessments and Science–Policy Forums to Sustain a Global Asset. https://lib.icimod.org/records/h8pwv-wdy26

depending on geography and season. The wider estimate nevertheless illustrates the scale of the economic relationships that may be affected by changing environmental conditions in the region.

Water supports agricultural production, industrial activities, hydropower generation and domestic supply. Food production, electricity generation and trade connect populations far beyond the immediate mountain environment. Changes in water availability can therefore have consequences extending through supply chains and markets, even where the effects on individual locations are indirect.

For TEOS 2100, this interconnectedness matters because environmental pressures in one region may contribute to resource insecurity elsewhere. The consequences depend on the availability of alternatives, infrastructure and the capacity of institutions to respond.

Resource competition is already occurring

Competition for water, agricultural land and energy is not a hypothetical development that will begin as the climate changes. It already influences relations between economic sectors, communities and countries. Agriculture accounts for approximately 72 per cent of global freshwater withdrawals, according to the United Nations World Water Development Report 2024. Increasing demand for food, industrial development and urban water supplies can place competing claims on the same resources.[78]

The challenges are often most visible where water availability fluctuates seasonally or where infrastructure cannot provide reliable access to all users. An agricultural community may depend on irrigation during the dry season, while nearby settlements require drinking water and businesses need water for production. Hydropower operators may seek to regulate flows to meet electricity demand. Where these uses cannot all be satisfied simultaneously, institutions must decide how resources are allocated.

Such decisions have distributional consequences. Some users may receive priority because of legal rights, economic influence or political power. Others may depend on customary arrangements or lack formal recognition of their claims. Resource competition can therefore occur without an absolute physical shortage. Water may be available within a river basin while particular communities remain unable to obtain sufficient supplies because of infrastructure deficiencies, pollution, unequal allocation or unaffordable costs.

The distinction between scarcity and access is essential. Scarcity describes a relationship between resource availability and demand. Resource insecurity also concerns the reliability, quality, affordability and distribution of access. These problems already contribute to social tensions and economic vulnerability. Climate-related changes may make them more difficult to manage.

[78] UNESCO & UN-Water (2024). The United Nations World Water Development Report 2024: Water for Prosperity and Peace. https://www.unwater.org/publications/un-world-water-development-report-2024

Climate change and the intensification of competing demands

Climate change can influence resource competition through several processes. Changes in precipitation and snowmelt may alter the seasonal availability of water. More frequent droughts can increase irrigation requirements while reducing supplies. Extreme rainfall and flooding may damage reservoirs, canals, transport infrastructure and agricultural land. Higher temperatures can increase water demand in some activities and reduce labour productivity, while changes in glacier systems may affect river discharge over different timescales.

These processes do not necessarily reduce annual water availability everywhere. However, greater variability can make it harder to reconcile demands that depend on predictable supplies. The interaction between water, energy and food production provides an example.

Hydropower generation requires sufficient river discharge and suitable operating conditions. Agriculture depends on water availability during growing seasons. Energy is often needed to pump, distribute and treat water.

A disruption affecting one system may therefore influence the others. A drought can reduce agricultural output while also constraining electricity generation. Higher electricity costs may increase the expense of irrigation. Food-price increases may place additional pressure on households already facing declining incomes. Such relationships are examined through the water-energy-food nexus.

The nexus approach recognises that decisions concerning one resource may create costs or benefits elsewhere. Integrated planning can help identify these interactions and reduce avoidable competition, but it cannot eliminate all conflicts of interest. The distribution of costs, benefits and risks remains a matter of political and institutional decision-making.

Transboundary competition over water

Several major river systems associated with the Hindu Kush Himalaya cross international borders. This creates relationships between upstream and downstream countries whose economic priorities and infrastructure needs may differ. Upstream states may seek to develop hydropower, irrigation or water-storage capacity. Downstream states may depend on established flow patterns for agricultural production, domestic supplies and electricity generation.

These interests can support cooperation where shared infrastructure, electricity trade or coordinated reservoir management produces mutual benefits. They can also generate disagreements concerning water allocation, environmental impacts and the authority to regulate river flows.

The Indus River system illustrates how resource competition can become embedded in wider political tensions. The Indus Waters Treaty of 1960 established a framework for water allocation between India and Pakistan. It also created mechanisms for information exchange and dispute resolution. Despite its long history, the treaty has become the subject of a serious dispute. Following the terrorist attack in Pahalgam in April 2025, India announced that it was placing the treaty in abeyance. Pakistan rejected this position.

On 31 August 2026, the Court of Arbitration constituted under the treaty issued an award finding that India's declared abeyance did not suspend or terminate the agreement. India rejected the tribunal's jurisdiction and maintained its position that the treaty remained in abeyance.[79]

The dispute demonstrates how established water-governance arrangements can become contested during a broader political crisis. It is not evidence that glacier retreat caused the confrontation. Nevertheless, changing hydrological conditions may create additional demands for cooperation in river-basin management, particularly where infrastructure decisions affect downstream users.

The Yarlung Tsangpo-Brahmaputra system provides another example. China's major hydropower development in the Great Bend region has raised questions in India and Bangladesh about potential downstream impacts, information sharing and environmental risk. The effects of the project will depend on its technical design, construction and future operation. The existence of the project does not establish that downstream water deprivation or conflict will necessarily follow. Its strategic significance lies partly in the unequal access to information and the different interests of upstream and downstream states.

For TEOS 2100, these examples demonstrate that resource competition cannot be understood through physical water availability alone. It also depends on political relationships, legal arrangements and confidence in the institutions responsible for managing shared systems.

Regional comparison: Central Asia

Central Asia provides a further example of competition and cooperation across interconnected water and energy systems. The Amu Darya and Syr Darya rivers are influenced by high-mountain hydrology, including snow and glaciers in the Pamir and Tian Shan regions. These systems should not be treated as geographically identical to the Himalayan river basins examined elsewhere in this report. They nevertheless provide a useful comparison because neighbouring countries depend on different uses of shared water resources.

Kyrgyzstan and Tajikistan possess substantial hydropower resources, while downstream states, including Uzbekistan, Turkmenistan and Kazakhstan, rely heavily on irrigated agriculture. Hydropower generation and irrigation can create competing demands regarding the seasonal timing of reservoir releases. These tensions have been managed through varying combinations of bilateral agreements, regional institutions and energy exchanges.

The World Bank's Central Asia Water and Energy Program identifies growing competition over water as a consequence of climate pressures, demographic change and economic development. It also highlights the potential benefits of improving technical coordination and

[79] Permanent Court of Arbitration (2026). Award on the Status of the Indus Waters Treaty in Respect of India's Decision on Abeyance, 31 August 2026. https://pca-cpa.org/en/cases/284/
Ministry of External Affairs, Government of India (2026). Matters Pertaining to the Illegally-Constituted So-Called Court of Arbitration, 31 August 2026 https://eoibelgrade.gov.in/index.php/listview/NzE2

sharing information between countries.[80] The example demonstrates that resource competition may persist over long periods without having a single environmental cause.

It also shows that institutional arrangements can influence whether competing demands are reconciled through negotiation or become sources of prolonged disagreement.

Resource scarcity, social tensions and conflict

Environmental pressure can reinforce existing conflicts over resources, but the relationship between climate change and armed violence is complex. Scheffran's research on climate change and security in South Asia and the Himalayan region identifies potential interactions between resource pressures, political instability, migration and conflict. It also examines the opportunities for cooperation arising from shared environmental challenges.[81]

The IPCC's Sixth Assessment Report concludes that climatic factors have historically played a comparatively small role in armed conflict when assessed alongside political, economic and social drivers. This finding should not be interpreted as evidence that resource competition or migration-related tensions are insignificant.

Armed conflict is only one possible outcome of social disagreement. Competition may also manifest through political confrontation, unequal allocation of resources, discriminatory practices, protests, legal disputes or the exclusion of particular groups from public services. These developments can weaken social cohesion without necessarily producing organised violence. The IPCC also identifies circumstances in which migration and displacement have been associated with social tensions in receiving areas, although the evidence linking these processes to violence remains limited and highly context-dependent.[82]

For TEOS 2100, the distinction is important. The hypothesis of increasing resource competition does not depend on the assumption that climate change will produce more wars. It concerns the possibility that societies will face increasingly difficult decisions about how essential resources are distributed, who has access to them and which institutions can resolve competing claims.

Population redistribution and the pressure on receiving regions

The possible contraction of viable settlement space, examined in Chapter 4.2, could intensify existing resource competition. Where water insecurity, declining agricultural productivity or repeated environmental hazards undermine livelihoods, some people may move towards regions that continue to offer more favourable living conditions. Receiving regions may consequently experience rising demand for housing, land, drinking water, employment and public services.

[80] World Bank (2026). Central Asia Water & Energy Program. https://www.worldbank.org/en/brief/2026/08/20/cawep

[81] Scheffran, Jürgen. (2014). Climate Change and Security in South Asia and the Himalaya Region: Challenges of Conflict and Cooperation.

[82] IPCC (2022). Climate Change 2022: Impacts, Adaptation and Vulnerability. Working Group II Contribution to the Sixth Assessment Report, Chapter 7: Health, Wellbeing and the Changing Structure of Communities, Section 7.2.7.

These pressures can occur even where the receiving locations remain environmentally viable. A city may have sufficient aggregate water resources while lacking the infrastructure required to supply additional neighbourhoods. Agricultural land may remain productive while expanding settlements create competing demands for its use. Housing shortages can increase competition for affordable accommodation, while public authorities may struggle to expand transport, healthcare and sanitation services.

The distribution of these pressures matters. Some residents may benefit economically from population growth, increased demand and a larger workforce. Others may experience rising living costs or reduced access to services. New arrivals may encounter similar difficulties, compounded by uncertain legal status, limited social networks or discrimination. Population redistribution can therefore alter existing relationships between groups and institutions.

For TEOS 2100, the potential cumulative effect is significant. If environmental pressures reduce the viability of some settlements while population movements increase demand elsewhere, competition may intensify in the regions that remain capable of accommodating additional residents. These receiving regions may themselves be affected by declining resource reliability. The combined pressures could make resource allocation progressively more difficult, even without a uniform global decline in resource availability.

Social tensions between mobile and settled populations

The relationship between incoming populations and established communities deserves separate consideration. People who relocate enter locations where access to land, employment, housing and public services is already governed by formal and informal arrangements.

Existing residents may have legal property rights, customary claims or established expectations concerning the use of communal resources. New arrivals may depend on temporary accommodation, rented property, informal employment or access arrangements negotiated with local authorities.

These differences can become sources of tension. Competition for affordable housing or employment may lead established residents to perceive newcomers as a threat to their economic security. Disagreements may arise about the allocation of public assistance, access to water or the use of agricultural and communal land. Newcomers, in turn, may experience exclusion, exploitation or restrictions on their ability to participate in decisions affecting their lives.

Such tensions are not necessarily the consequence of cultural differences. They can arise where economically vulnerable groups compete for limited opportunities or where institutions allocate resources in ways that are perceived as unfair. The World Bank's 2023 synthesis *Social Cohesion and Forced Displacement*, drawing on 26 background studies, found that displacement can exacerbate existing inequalities and create new potential for conflict, particularly where public services are strained and economic opportunities are limited.[83]

[83] World Bank (2023). Social Cohesion and Forced Displacement: A Synthesis of New Research. https://openknowledge.worldbank.org/entities/publication/45757341-5bf9-56b0-bcda-a8a0772337c4

The report also found that inclusive development policies and investments can reduce inequalities, ease social tensions and strengthen relationships between displaced and host communities. These findings cannot be transferred mechanically to every form of climate-related migration. Many movements involve different legal circumstances, degrees of choice and patterns of settlement. They nevertheless provide evidence that the relationships between incoming and established populations are shaped by the distribution of resources and the quality of local institutions.

For TEOS 2100, repeated or sustained population redistribution could increase the significance of these relationships. The distinction between settled and mobile populations may become politically consequential where access to housing, social protection or public participation depends on permanent residence. If institutions cannot accommodate changing patterns of residence, competition over resources may become intertwined with disputes over belonging, rights and representation.

Conflict prevention and the governance of shared resources

The existence of resource competition does not mean that social conflict is unavoidable or that the available responses are limited to crisis management. Governments, international organisations and local communities already use methods intended to reduce tensions between population groups and improve the management of shared resources. One approach is to expand public services in ways that benefit both established residents and newcomers.

Investments in water infrastructure, sanitation, healthcare, education and transport can reduce competition where existing capacity is inadequate. The UNHCR's settlement-planning guidance emphasises the need to identify and mitigate conflict risks between displaced people and host communities over natural resources, ensure equitable access to basic services and address disputes concerning housing, land and property.[84]

These principles are relevant beyond conventional humanitarian settlements. They demonstrate how planning can account for the interests of both incoming and established populations.

A second approach involves participatory resource allocation. Including affected communities in decisions about water distribution, land use and infrastructure investment can improve transparency and make competing interests visible before disputes escalate. Participation cannot remove scarcity, but it can provide procedures through which disagreements are addressed. Transparent allocation rules and accessible grievance mechanisms can further reduce perceptions of arbitrary or discriminatory treatment.

Community mediation provides another instrument. Local mediation structures can help resolve disagreements over housing, land, property or access to shared facilities without requiring every dispute to become a lengthy judicial or political confrontation. UNDP's 2022 study of collaborative dispute resolution in Syria documents how community-based

[84] UNHCR. Principles and Standards for Settlement Planning. https://emergency.unhcr.org/emergency-assistance/settlement-and-shelter/guidance-settlements/principles-standards-settlement-planning

mechanisms have been used to address conflicts involving housing, land and interpersonal relationships in displacement-affected communities.[85]

The context differs from climate-related migration in the Hindu Kush Himalayan region, but the experience demonstrates that locally accessible dispute-resolution mechanisms can provide practical alternatives to escalation.

Economic integration also matters. Access to lawful employment, education and opportunities for enterprise can reduce prolonged dependence on assistance and allow newcomers to contribute to local economic activity. Measures that support both incoming and established residents may be more effective than programmes that treat the groups as having entirely separate needs.

Finally, cooperation between levels of government is necessary when population change affects several jurisdictions. Local authorities may be responsible for housing and public services but lack the financial resources or legal authority required to respond effectively. Regional and national institutions may therefore need to coordinate financing, infrastructure planning and the protection of rights. UNDP's 2025 toolkit on multi-level governance in crisis-affected settings provides approaches for improving coordination and inclusive decision-making across institutional levels.[86]

These tools do not guarantee social cohesion. Their effectiveness depends on political commitment, administrative capacity, impartial implementation and meaningful participation. They nevertheless demonstrate that resource competition can be managed through established methods rather than being treated as an unavoidable source of conflict.

The potential escalation of resource competition towards 2100

For TEOS 2100, the central foresight hypothesis concerns the interaction of several developments. Competition for water, land, food and energy already exists within and between societies. Environmental change may affect the reliability of these resources, while demographic and economic developments influence demand. If some settlements lose viability, population movements may increase pressure on locations that remain capable of supporting residence and economic activity.

Where these receiving regions experience environmental constraints of their own, the demands placed on resources and institutions may become increasingly difficult to reconcile. Under such circumstances, existing disputes may intensify and new conflicts of interest may emerge. The process would not necessarily be continuous or uniform. Competition could increase rapidly after a major environmental event, develop gradually through economic change or decline where adaptation and institutional cooperation improve resource security.

The geographical distribution of competition would also depend on migration routes, economic opportunities, infrastructure and public policy. TEOS 2100 does not assume that a

[85] United Nations Development Programme (UNDP) (2022). Collaborative Dispute Resolution: An Effective Out-of-Court Remedy in Syria. https://www.undp.org/publications/dfs-collaborative-dispute-resolution-effective-out-court-remedy-syria

[86] United Nations Development Programme (UNDP) (2025). Multi-Level Governance in Crisis-Affected Settings https://www.undp.org/publications/multi-level-governance-crisis-affected-settings

specific number of people will move or that all resource systems will become progressively scarcer. Its hypothesis is that the interaction between declining settlement viability in some regions and increasing demand in others could create cumulative pressures extending beyond the original areas of environmental disruption.

The risk of social tension would be greater where institutions are unable to maintain equitable access to resources and resolve competing claims. Conversely, effective infrastructure planning, inclusive governance and conflict-resolution mechanisms could reduce these pressures. The future development of resource competition therefore depends partly on environmental conditions and partly on institutional choices.

Implications for TEOS 2100

Resource competition connects the environmental limits of settlement to questions of social organisation and governance. The ability of people to remain in a location depends partly on their access to water, food, energy, land and essential services. Where these resources become unreliable or difficult to obtain, migration may become one response. However, relocation does not remove resource needs. It redistributes them geographically. Receiving regions must accommodate additional demands, while established residents and newcomers may hold different claims on available resources. These relationships can create tensions, but they can also generate opportunities for cooperation and institutional change.

For TEOS 2100, the issue is therefore broader than the future availability of natural resources. It concerns how societies can maintain fair and secure access to resources when populations become more mobile and the geographical conditions supporting permanent settlement change. Existing instruments provide a starting point: shared resource management, participatory planning, inclusive service provision, mediation and cooperation between jurisdictions.

The long-term question is whether these approaches can be adapted to settlement patterns in which residence becomes less stable and established distinctions between permanent and temporary populations become increasingly difficult to maintain. A post-settlement perspective does not require the disappearance of resource competition. It raises the possibility that access to essential resources and services may need to become less dependent on permanent residence, established property relations or membership in a single local community. This creates a direct connection to the following section, which examines the relationship between temporary access and ownership of land.

4.4 Temporary Access vs. Ownership

The potential contraction of viable settlement space raises questions about how people obtain access to land and housing when their place of residence changes. Property ownership, rental arrangements, customary land rights and public land allocation already determine who can occupy, use and benefit from particular locations. These arrangements influence access to shelter, livelihoods, infrastructure and essential services.

When people move into an established settlement, they enter a space in which land and housing are generally subject to existing rights, regulations and economic interests. This can create tensions between the needs of incoming populations and the rights and expectations

of established residents, property owners and public authorities. As discussed in Chapter 4.3, these tensions are already visible in disputes over housing costs, land use and access to services. They may become more difficult to manage where environmental change contributes to sustained population redistribution.

However, permanent individual ownership is not the only historical or contemporary basis for organising access to land. Mobile pastoral societies demonstrate how access can be governed through collective rights and customary institutions. The historical commons of Southern Germany and Switzerland provide a related example from settled agricultural communities. Both traditions show that shared resources can be managed through established rules without requiring every individual to own the land they use.

For TEOS 2100, these arrangements offer a useful perspective on how secure access to land and resources might be maintained under conditions of greater human mobility. The central challenge is not simply a choice between temporary access and permanent ownership. It concerns how rights of ownership, occupation and use can coexist when relationships between people and places become less permanent.

Land ownership and security of tenure

Property ownership is one means of obtaining secure access to land and housing, but it is not the only one. Tenure refers to the relationships and rules governing the possession, occupation and use of land or property. These relationships can include private ownership, long-term leases, rental agreements, customary rights, communal tenure and other recognised arrangements.

The Global Land Tool Network, established through UN-Habitat and its partners, developed the concept of a *Continuum of Land Rights* to describe this diversity. The approach recognises that legitimate claims to land are not limited to formally registered private ownership. Different rights may coexist, and their security depends on legal recognition, administrative practices and local institutions.

For example, a tenant may have substantial legal protection against arbitrary eviction despite not owning the building in which they live. A community may collectively own a forest while granting individual members specified rights to obtain timber or firewood. A pastoral household may own livestock while relying on collectively governed grazing land. These examples involve different relationships between ownership and use.

The relevant consideration is therefore not ownership alone but *security of tenure*: the extent to which individuals or communities can occupy or use land without facing arbitrary loss of their rights. For people whose residence changes frequently, secure rental or occupancy rights may be more practical than acquiring property at every location. For established communities, collective or customary rights may help protect access to resources that support their livelihoods. The recognition of diverse tenure systems provides a starting point for examining how ownership and access might be organised within more mobile societies.[87]

[87] UN-Habitat / Global Land Tool Network. *Continuum of Land Rights*. Conceptual framework for understanding diverse forms of legitimate land tenure, including communal, customary, rental and

Land use in nomadic and pastoral societies

Mobile pastoral societies demonstrate that stable social institutions can exist without making permanent individual ownership of grazing land the principal basis of resource access. In many pastoral systems, mobility is necessary because vegetation, water and other resources vary across locations and seasons. Pastoralists may move livestock between grazing areas according to rainfall, altitude and the availability of forage.

Such movements do not necessarily involve the absence of territorial rights. Groups may possess recognised rights to use particular pastures, follow established routes or obtain access through agreements with neighbouring communities. These rights can be inherited, negotiated or regulated through customary institutions.

The Food and Agriculture Organization of the United Nations (FAO) identifies the recognition of customary tenure and livestock mobility as important conditions for sustainable pastoral land governance. Its technical guide *Improving Governance of Pastoral Lands* emphasises that pastoral tenure systems may combine communal rights, negotiated access and individual ownership of particular assets.[88] The distinction between ownership and use is significant. Livestock may be privately owned while grazing land is collectively governed.

Customary institutions may regulate who is permitted to use particular resources, when access is allowed and how disputes are resolved. The resulting arrangements are neither unrestricted nor necessarily egalitarian. They may distinguish between members and non-members, and they can contain established hierarchies or competing claims. Nevertheless, they demonstrate that mobility can be incorporated into recognised systems of rights and responsibilities.

The Amazigh Agdal system

An example of customary resource governance can be found among Amazigh communities in Morocco's High Atlas Mountains. The Amazigh, historically referred to in much European literature as Berbers, include communities with diverse livelihoods and land-use practices.

Some practise mobile or transhumant pastoralism, while others engage primarily in settled agriculture or combine different economic activities. It would therefore be inaccurate to describe Amazigh societies as uniformly nomadic. In parts of the High Atlas, customary institutions regulate access to grazing land, forests and water through arrangements known as *Agdal*.

ownership arrangements. https://unhabitat.org/framework-for-evaluating-continuum-of-land-rights-scenarios

[88] Food and Agriculture Organization of the United Nations (FAO) (2016). *Improving Governance of Pastoral Lands: Implementing the Voluntary Guidelines on the Responsible Governance of Tenure of Land, Fisheries and Forests in the Context of National Food Security*. https://www.unccd.int/resources/unccd-library/improving-governance-pastoral-lands-implementing-voluntary-guidelines

The Agdal system involves collectively established rules[89] concerning the use of particular resources. In pastoral areas, grazing may be temporarily restricted to allow vegetation to regenerate. Access is subsequently reopened according to seasonal conditions and community decisions. These rules are maintained through customary institutions, including local assemblies commonly referred to as *jma'a*.

Research on the Yagur pastoral territory[90] describes how grazing closures and collective decisions regulate the use of mountain pastures. The Yagur Agdal is not simply an area without private property. It is a resource system in which different rights and responsibilities are attached to land, livestock and community membership. Bendella and colleagues (2025) show that High Atlas Amazigh land governance involves combinations of individual property, collective rights and customary use arrangements. The Agdal system has also faced pressures from changing economic relationships, land policies and environmental conditions.[91]

Its relevance to TEOS 2100 lies in the distinction between access and ownership. The ability to use land can be governed through recurring rights and collective agreements without requiring each user to possess an exclusive title to the territory. These arrangements depend on institutions that regulate access and resolve disputes.

The Allmende in Southern Germany and Switzerland

A comparable principle can be identified in the historical *Allmende* of German-speaking Central Europe. Unlike the pastoral systems discussed above, the Allmende was closely associated with established villages and settled agricultural communities. The term generally referred to land and resources reserved for the collective use of a defined community.

Depending on the region, these resources included grazing land, forests, meadows, water and other areas that supported local economic activity. Individual households often cultivated their own fields or occupied their own farmsteads while relying on common resources for livestock grazing, timber, fuel and other needs. The Allmende therefore formed part of a broader system in which individual and collective rights existed alongside one another.

The *Historical Dictionary of Switzerland* describes the Allmend as land set aside for collective economic use by eligible inhabitants of one or several settlements. Within traditional village economies, it constituted a distinct area alongside cultivated fields and residential property.[92]

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[89] Burke, A. (2026). Partial Protections: Customary Law and the Governance of Moroccan Collective Lands. *Nomadic Peoples*, 30(1), 76–103. https://doi.org/10.3828/whpnp.63904085203743

[90] Domínguez, P. (2021). Assessing the Economic Contribution of the Yagur: A Pastoral Territory Managed Communally by the Traditional Berber System of the Agdal (Moroccan High Atlas). *Quaderni Storici*, 3/2021, 799–822. https://doi.org/10.1408/104535

[91] Bendella, A., D'Ambrosio, U., Caruso, E., Martin, G., M'Sou, S., Romera, M. C., & Dominguez, P. (2025). Rights to Land among Amazigh Peoples in Morocco: The Case of the High Atlas. In W. Nikolakis (Ed.), *Land Rights Now: Global Voices on Indigenous Peoples and Land Justice* (pp. 229–248). Cambridge University Press. https://doi.org/10.1017/9781009521581.015

[92] Leonhard, M. (2001). Allmend. In *Historisches Lexikon der Schweiz*. https://hls-dhs-dss.ch/de/articles/013704/2001-05-17/

The Allmende was not necessarily land without an owner. It could be owned by a municipality, a recognised community association or another legal entity, while individual members held defined rights to use its resources. In other cases, historical relationships between collective use and legal ownership were more complex.

The relevant distinction was often between the entity holding or administering the resource and the individuals entitled to benefit from it. This arrangement demonstrates that permanent settlement did not require every resource essential to a household's livelihood to be held as private individual property.

Rules and institutions governing the Allmende

The Allmende was not generally an unrestricted resource available to anyone. Communities established rules determining who could use common land and under which conditions. Access rights could be linked to ownership of a farm, possession of a house, municipal citizenship or membership in a recognised association.

In the Swiss historical context, such entitlements were often known as *Gerechtigkeiten* or, in some regions, *Rechtsamen*. The rules could determine how many animals a household was permitted to graze, when grazing was allowed and what quantities of timber could be obtained. Some arrangements took account of the carrying capacity of local pastureland. Communities also developed procedures for monitoring use and addressing disputes.[93]

These institutions were necessary because common resources were limited. Competition could arise between households with different livestock holdings, between neighbouring villages or between existing members and newcomers. As populations increased during the early modern period, the pressure on common land intensified. Local authorities sometimes restricted access or linked rights more firmly to property and inherited membership.

The history of the Allmende therefore illustrates two related developments. Collective use could support the economic stability of settled communities by preserving access to resources that individual households could not necessarily provide for themselves. At the same time, collective rights could become mechanisms of exclusion where access depended on established community membership.

The distinction matters for TEOS 2100. The existence of a collectively managed resource does not by itself guarantee that mobile populations or newly arriving residents will be able to use it. An institutional system designed to protect existing users may also restrict access for others.

Common land and the transformation of property relations

The role of common land changed considerably over time. In parts of Southern Germany, historical processes of land division, agricultural reform and privatisation reduced or transformed common property.

[93] Leonhard, M. (2009). Nutzungsrechte. In *Historisches Lexikon der Schweiz*. https://hls-dhs-dss.ch/de/articles/025978/2009-08-12/

These developments did not occur uniformly. Some common lands were divided among individual users, while others remained under communal or corporate management. The historical relationship between common use and individual property also generated legal disputes. Research on late-medieval Southwestern Germany documents conflicts between urban authorities, monasteries and village communities over grazing and forest rights.

These disputes involved competing claims to resources and the legal authority to regulate their use. They demonstrate that the management of common land was already a matter of negotiation, institutional power and sometimes litigation.[94] The historical development of the Allmende should therefore not be interpreted as a simple transition from communal harmony to private ownership. Different tenure arrangements coexisted, changed and were contested over time.

The significance for TEOS 2100 is that the relationship between ownership and access has never been institutionally fixed. Societies have repeatedly modified these relationships in response to demographic, economic and political developments.

Contemporary Swiss common-property institutions

The Allmende is not exclusively a historical phenomenon. In Switzerland, organisations originating in the collective use of forests, grazing land, alpine pastures and other resources continue to exist. These include various forms of *Korporationen*, *Allmendkorporationen* and *Alpgenossenschaften*. Their legal status differs between cantons and institutions. Some administer communal property, while others manage resources held through established corporate ownership arrangements.

The *Historical Dictionary of Switzerland* notes that these institutions continue to manage and use common forests, alpine pastures and other assets. Some have also developed economic and social activities beyond their original agricultural functions.[95]

Their continued existence demonstrates that collective resource governance can coexist with contemporary legal systems and market economies. However, these institutions should not be equated with unrestricted public access. Membership and use rights may remain subject to established legal criteria. The contemporary Allmende therefore offers an institutional example rather than an immediately transferable solution. It shows that collective ownership and differentiated rights of use can persist within modern societies.

For TEOS 2100, this provides evidence that alternative relationships between ownership and access are compatible with permanent settlement and modern legal institutions.

[94] Zückert, H. (2003). *Allmende und Allmendaufhebung: Vergleichende Studien zum Spätmittelalter bis zu den Agrarreformen des 18./19. Jahrhunderts*. Stuttgart: Lucius & Lucius. See also the scholarly review in H-Soz-Kult: https://www.hsozkult.de/publicationreview/id/reb-4544

[95] Stadler, H. (2008). Korporationen. In *Historisches Lexikon der Schweiz*. https://hls-dhs-dss.ch/articles/010262/2008-10-30/ ; see also *Genossenschaft*, updated 2024, https://hls-dhs-dss.ch/de/articles/008970/2024-03-04/

What the Amazigh and Allmende examples demonstrate

The Amazigh Agdal system and the historical Allmende developed in different environmental, economic and cultural circumstances. One is closely associated with the seasonal management of resources in mountain pastoral systems. The other was widely integrated into settled agricultural communities in Central Europe. Despite these differences, both demonstrate that access to essential resources can be organised through collective institutions.

Individual households do not necessarily require exclusive ownership of every resource on which their livelihoods depend. Rights of use can be regulated according to seasons, resource availability, community membership or other established criteria. These examples also demonstrate that collective governance involves responsibilities. Rules must be maintained, resource use monitored and disputes resolved. Where access is limited, institutions must determine who is entitled to use the resource and how competing claims are reconciled.

This raises a question directly relevant to more mobile societies. If people increasingly maintain livelihoods across several locations, how can institutions provide secure access without relying exclusively on inherited membership or permanent local residence? Historical systems demonstrate that ownership and use can be separated. They do not, however, provide a complete answer to the problem of inclusion. Any future arrangement would need to protect existing rights while offering accessible and legitimate forms of participation to newcomers.

Informal settlements and temporary residence

The contrast with informal urban settlements helps clarify these difficulties. Informal settlements may develop where population growth exceeds the supply of affordable housing or where residents face barriers to formal land access. Their populations are not necessarily temporary or exclusively composed of migrants.

Many informal settlements have existed for decades and contain established communities with extensive social and economic relationships. Nevertheless, residents may experience insecure tenure, inadequate infrastructure and exposure to environmental hazards. Where incoming populations cannot obtain affordable housing through formal markets, they may rely on informal rental arrangements, shared accommodation or occupancy without recognised legal protection.

These conditions can increase the risk of eviction and exploitation. They may also create disputes between residents, landowners, local authorities and developers. Unlike formally recognised common-property institutions, informal urban residence may lack an effective legal framework protecting occupants against displacement. This distinction is not absolute. Informal communities may establish their own rules, and some forms of customary tenure may also exist in urban settings. However, a recurring difficulty is the difference between socially recognised occupation and legally enforceable rights.

For TEOS 2100, informal settlements demonstrate the risks that may arise when housing needs increase faster than institutions can provide secure and affordable access.

Urban redevelopment and displacement in Nanjing

Urban redevelopment in Nanjing, China, provides an example of how competing claims to land can affect residential security and social inequality. Yuan and Song (2020) examined the reconstruction of shantytown areas in Nanjing between 2008 and 2020. Their study covered 434 redevelopment plots and included detailed analysis of two cases: Xijie, located on state-owned land, and Nanhe, associated with collectively owned land.[96]

The reconstruction programme sought to improve housing conditions, modernise urban infrastructure and make more effective use of valuable urban land. It also formed part of broader economic and administrative strategies through which local authorities promoted development and increased the value of urban property. The study found that redevelopment improved housing conditions for many affected households. In Xijie, the reported average residential floor area per person increased from 7.6 to 26.9 square metres following reconstruction.

However, these improvements were accompanied by uneven outcomes. Lower-income households from centrally located neighbourhoods were frequently relocated to housing developments on the urban periphery.Some household s obtained more secure housing but experienced longer journeys to employment, reduced accessibility and changes in their social networks.

The economic benefits of redevelopment were also distributed unequally. Local authorities and development interests benefited from the increased value of redeveloped land, while residents possessed different levels of bargaining power depending on their housing circumstances and land rights. Compensation and resettlement arrangements varied between the areas examined.

The study found that households associated with collective land could obtain different benefits from redevelopment than residents of older housing on state-owned land. These differences illustrate the importance of tenure arrangements in determining the consequences of relocation. The Nanjing experience demonstrates that improved physical housing conditions do not necessarily guarantee an improvement in overall living circumstances. Location, accessibility, affordability and social relationships remain relevant to the quality of resettlement.

The case concerns urban redevelopment rather than climate-related migration. Its relevance to TEOS 2100 lies in the institutional mechanisms through which land rights, planning decisions and compensation influence access to housing and economic opportunities.

Three approaches to organising access

The Amazigh Agdal system, the historical Allmende and urban redevelopment in Nanjing illustrate different ways in which ownership and access are governed. In the Agdal system, access to resources is regulated through customary institutions and recurring use rights. Seasonal mobility is incorporated into established rules. In the Allmende, settled

[96] Yuan, Y., & Song, W. (2020). Mechanism and Effect of Shantytown Reconstruction under Balanced and Full Development: A Case Study of Nanjing, China. *Sustainability*, 12(19), 7979. https://doi.org/10.3390/su12197979

communities maintain collective access to resources that support individual households. Ownership and use can be divided between communal institutions and eligible members. In the Nanjing redevelopment process, changes in residential access are organised through formal planning, property arrangements, compensation and relocation.

The cases are not directly equivalent. They differ in scale, economic organisation, legal systems and the resources involved. However, they reveal a common institutional problem: access to land is never determined by physical availability alone. It depends on recognised rights, decision-making authority and the ability to reconcile competing claims.

The examples also demonstrate that ownership and use do not necessarily have to belong to the same actor. A community may own land while granting use rights to members. A municipality may hold land while allowing occupation under specified conditions. A household may own property but temporarily reside elsewhere.

For TEOS 2100, this separation provides a basis for examining how secure access might be maintained if more people live or work across several locations.

Displacement, housing rights and overlapping claims

People displaced by environmental change may retain rights to homes or land in their places of origin while requiring accommodation elsewhere. A displaced household may possess a home that is temporarily inaccessible or damaged. It may rent accommodation in a receiving city while maintaining legal claims to its original property. In other circumstances, return may become unsafe or economically impractical, creating a need for longer-term housing arrangements.

These situations require mechanisms capable of addressing overlapping rights and obligations. UN-Habitat and the Global Land Tool Network examined these questions in their 2024 report *Policy Directions: Housing, Land and Property Solutions to Resolve and Prevent Displacement*. The report draws on 24 case studies across 14 countries and identifies approaches involving secure tenure, affordable housing, land administration, compensation, restitution and dispute resolution.[97]

A related UN-Habitat study examines displacement in customary tenure contexts, including situations in which people move from or into areas governed through communal land rights. It demonstrates the difficulties that can arise when customary claims are not adequately recognised within formal legal and administrative systems.[98]

These findings are relevant to the examples discussed above. The management of population movement cannot be reduced to assigning a new place of residence. It also involves the recognition of existing property interests, the creation of secure access at receiving locations and mechanisms for resolving disagreements.

[97] UN-Habitat & Global Land Tool Network (2024). *Policy Directions: Housing, Land and Property Solutions to Resolve and Prevent Displacement*. Nairobi: UN-Habitat. https://unhabitat.org/policy-directions-housing-land-and-property-solutions-to-resolve-and-prevent-displacement

[98] UN-Habitat & Global Land Tool Network (2024). *Durable Housing, Land and Property Solutions for Customary Displacement Contexts*. Nairobi: UN-Habitat. https://unhabitat.org/durable-housing-land-and-property-solutions-for-customary-displacement-contexts-report-brief

Institutional tools for secure and flexible access

Existing land-governance approaches provide several instruments that may be relevant to future settlement patterns. Recognition of different tenure arrangements can allow people to obtain protected occupancy rights without requiring full ownership. Land documentation can clarify claims, provided that collective and customary rights are also recognised.

Rental housing, long-term leases and other contractual arrangements can provide security where ownership is impractical. Public land-use planning can identify locations suitable for additional housing while protecting agricultural land, infrastructure and environmentally sensitive areas. Compensation and restitution mechanisms can address losses associated with displacement and public redevelopment.

Accessible mediation and legal remedies can help resolve disputes. The historical Allmende and the Agdal system introduce an additional principle. Rights of use may be organised collectively and governed through rules concerning eligibility, duration and resource availability. Such arrangements can provide stable access without requiring exclusive individual ownership. However, they also raise questions of inclusion.

A system based solely on inherited membership may be poorly suited to receiving new populations. Institutions may therefore need to distinguish between the protection of existing rights and the criteria under which newcomers can obtain legitimate access. This could involve negotiated use agreements, transparent allocation procedures and arrangements that recognise both community interests and individual rights. These are possible directions for institutional development rather than established solutions for all contexts.

Their feasibility would depend on legal frameworks, social acceptance, resource availability and administrative capacity.

Property rights under changing environmental conditions

Climate-related environmental change can create difficulties for property systems even where population movement does not occur. Land may remain legally owned while becoming increasingly difficult or dangerous to occupy. Flooding may damage buildings, erosion may alter physical boundaries, and changes in water availability may reduce the economic value of agricultural property.

Formal ownership does not guarantee that land can continue to support its previous use. This creates questions concerning the allocation of adaptation costs and the consequences of environmental loss. Should public resources be used to protect properties where adaptation is technically feasible but expensive? How should compensation be determined where planned relocation becomes necessary? What happens to land rights when former residential areas can no longer be safely occupied?

The answers depend on legal systems, the interests of affected communities and the availability of alternatives. Nevertheless, these questions demonstrate that property rights and environmental viability are related but distinct. The legal recognition of ownership cannot prevent environmental deterioration. At the same time, environmental change does not automatically extinguish legitimate property claims.

For TEOS 2100, institutions may therefore need to address continuing rights in places that people can no longer occupy alongside new rights in locations where they seek residence.

Implications for TEOS 2100

The possible emergence of more mobile settlement patterns challenges the assumption that secure access to land and essential resources must depend on permanent individual ownership in a single location. Historical and contemporary societies provide evidence that different institutional arrangements are possible.

The Amazigh Agdal system demonstrates how access to grazing resources can be coordinated through customary rules and seasonal mobility. The Allmende shows that settled agricultural communities have also relied on collective resource governance alongside individual property. Both examples demonstrate that ownership, access and use can be separated through recognised institutions. However, they also reveal the importance of membership rules and the possibility of excluding outsiders.

The Nanjing case illustrates a different problem. Formal redevelopment and the redistribution of residential access can improve housing conditions while creating disadvantages through relocation, unequal bargaining power and reduced access to economic opportunities.

Together, the examples show that tenure security depends on more than the formal ownership of land. It also requires clear rights of use, effective institutions and access to the wider conditions necessary for a sustainable livelihood. For TEOS 2100, the potential contraction of viable settlement space could increase the importance of these arrangements. Where additional populations seek residence in receiving regions, existing ownership and tenure systems may face growing demands to accommodate new users without arbitrarily removing established rights. A post-settlement perspective does not require the abolition of private property. It raises the possibility that secure access to land, housing and essential services may need to become less dependent on permanent ownership or residence in a single location.

The historical examples suggest that collective management, recurring use rights and negotiated access can form part of such arrangements. Their relevance is not that they provide ready-made solutions for future societies. They demonstrate that different relationships between people, property and resources have already existed and, in some cases, continue to operate.

The institutional challenge is to develop arrangements that protect established rights while providing legitimate and secure access to people whose residence and livelihoods become more mobile. Whether such systems can be adapted to larger and more diverse populations remains an open question. For TEOS 2100, the separation of ownership, access and use therefore represents a possible principle for organising settlement under changing environmental conditions. The following section examines the potential emergence of more mobile forms of social and economic organisation.

4.5 Emergence of Mobile Societies

Human mobility is not a new phenomenon. Throughout history, societies have developed different ways of organising residence, livelihoods and access to resources across geographical space. Permanent settlement has become a dominant form of social and political organisation in much of the contemporary world, but it has never been the only one. Pastoral communities, seasonal agricultural workers, trading populations and households maintaining connections across several locations demonstrate that mobility can form a regular part of economic and social life.

Environmental change may increase the significance of such arrangements. As discussed in the preceding sections, water insecurity, declining settlement viability and competition over resources could influence where people can sustain their livelihoods. Some households may relocate permanently. Others may move temporarily, maintain residences in several places or distribute their economic activities across different regions.

These developments raise a question for TEOS 2100: could sustained environmental pressures contribute to the emergence of forms of social organisation in which mobility becomes a normal and institutionally recognised element of life? This does not imply that climate-displaced populations will become nomadic or that permanent settlement will disappear. The possible emergence of more mobile societies concerns the relationship between movement, residence, economic activity and institutional membership.

Climate-related migration and the limits of numerical projections

Climate change can influence migration by affecting livelihoods, housing, health and access to essential resources. Its effects interact with economic opportunities, family relationships, political circumstances and the resources available to households. The United Kingdom's *Foresight* report on migration and global environmental change, published in 2011, identified these interactions and emphasised that environmental change could contribute to both migration and immobility.[99]

Some households may move because environmental conditions make previous livelihoods increasingly difficult to sustain. Others may use migration as a strategy for maintaining income and financing adaptation in their communities of origin. People with insufficient resources may be unable to move, even where environmental risks are substantial.

Consequently, rising environmental pressure does not necessarily produce a corresponding increase in migration. The World Bank's *Groundswell* analysis provides a basis for examining possible future patterns. Its second report, published in 2021, projected that up to 216 million people could become internal climate migrants across six world regions by 2050 under the most adverse scenario considered.

For South Asia, the corresponding estimate was approximately 40 million. These figures are conditional modelling results rather than predictions of actual movements. They refer to internal migration influenced by selected climate impacts and do not include every form of

[99] Government Office for Science (2011). *Migration and Global Environmental Change: Future Challenges and Opportunities*. Final Project Report. London: Government Office for Science. https://www.gov.uk/government/collections/migration-and-global-environmental-change

disaster displacement or cross-border migration. The analysis also indicates that climate action and inclusive development could substantially reduce projected migration.[100]

For TEOS 2100, the findings support the possibility that environmental change could alter population distribution over time. They do not establish that mobile societies will necessarily emerge or that a specific number of people will live without permanent residence by 2100. The form of mobility matters as much as its scale.

Existing forms of mobile social organisation

Mobile societies cannot be defined simply by the absence of a fixed home. Different groups organise movement in different ways, according to their livelihoods, cultural traditions and relationships with particular territories. Pastoral nomadism generally involves the movement of people and livestock in response to the seasonal distribution of grazing resources. Transhumance refers to recurring seasonal movements between grazing areas, often involving established routes and relationships with permanent settlements. Agropastoral systems combine livestock husbandry with agricultural production and may involve both seasonal movement and settled residence.

These categories overlap in practice. A household may maintain a permanent dwelling while some family members move with livestock. Other members may cultivate land or participate in trade. Mobility can therefore be incorporated into a society without requiring all its members to move continuously.

The Himalayan region contains a diversity of such arrangements. Bhasin (2011) documents pastoral and transhumant communities whose livelihoods depend on seasonal access to pastures and established social relationships across mountain environments.[101] More recent research identifies changing pressures on these systems, including restrictions on grazing routes, shifts in land use, economic transformation and environmental change[102]. These developments demonstrate that existing mobile societies are neither isolated from contemporary institutions nor necessarily able to maintain traditional mobility under changing conditions. Their organisation depends on rights of access, economic opportunities and the continued viability of routes and resources.

Himalayan pastoralism as adaptive mobility

Pastoral mobility in the Himalaya provides an example of how movement can help communities use environmentally variable landscapes. Seasonal differences in temperature, snow cover and vegetation influence the availability of grazing resources. Moving livestock between locations allows pastoralists to make use of pastures that would not support continuous grazing throughout the year.

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[100] World Bank (2021). *Groundswell Part 2: Acting on Internal Climate Migration*. Washington, DC: World Bank. https://www.worldbank.org/en/news/press-release/2021/09/13/climate-change-could-force-216-million-people-to-migrate-within-their-own-countries-by-2050

[101] Bhasin, V. (2011). Pastoralists of Himalayas. *Journal of Human Ecology*, 33(3), 147–177. https://doi.org/10.1080/09709274.2011.11906357

[102] International Centre for Integrated Mountain Development (ICIMOD), UNDP, IGES & UNU (2026). *Human Security Under Climate Stress in the Hindu Kush Himalaya Region: A Scoping Assessment*. https://lib.icimod.org/records/r1w5q-db404

The Gaddi pastoralists of Himachal Pradesh are among the communities that practise seasonal movement between lower and higher elevations. Other Himalayan pastoral and agropastoral groups use different systems according to local geography, livestock and social organisation. These movements are supported by knowledge of routes, grazing conditions and access arrangements.

Such knowledge develops over generations and forms part of the communities' social and economic institutions. A 2023 review of Himalayan pastoralism[103] found that these systems face changing ecological and socioeconomic conditions, including restrictions on mobility and competition over access to grazing resources. It also identified adaptive responses through changes in herd composition, livelihood diversification and grazing practices.

A further review published in April 2026 examined pastoral livelihoods in the Kashmir Himalayas.[104] The authors identified interacting pressures from climatic change, invasive plant species and the erosion of traditional ecological knowledge. Changes in snowmelt, precipitation and vegetation patterns can influence the timing of seasonal movement and the availability of forage. These pressures may reduce the effectiveness of mobility arrangements that previously supported adaptation.

The example illustrates an important distinction. Mobility can be an effective response to environmental variability, but it is not automatically resilient under all conditions. Its effectiveness depends on continued access to suitable locations, the availability of resources and the institutions governing movement.

For TEOS 2100, the significance of Himalayan pastoralism lies in demonstrating how livelihoods can be organised across several locations. It does not establish that transhumance can serve as a general model for populations displaced from cities, agricultural settlements or industrial economies.

Indigenous mobility and the consequences of enforced settlement

Indigenous societies provide further perspectives on the relationship between mobility, territory and social organisation. Whyte, Talley and Gibson (2019) examine Indigenous traditions of mobility in North America, focusing in part on Anishinaabe histories and philosophies. Their analysis challenges the assumption that contemporary discussions of climate-related mobility describe an entirely new phenomenon.[105]

For many Indigenous peoples, movement has historically been connected to seasonal resource use, trade, family relations and responsibilities towards particular places. These patterns were frequently disrupted by colonial policies. Restrictions on movement, land dispossession, compulsory settlement and the establishment of institutions tied to

[103] Singh, R., Kerven, C. Pastoralism in South Asia: Contemporary stresses and adaptations of Himalayan pastoralists. *Pastoralism* 13, 21 (2023). https://doi.org/10.1186/s13570-023-00283-7
[104] Sheergojri, I. A., Ahmad, J., & Rashid, I. (2026). Pastoral Resilience under Threat: Impacts of Climate Change, Invasive Plant Species, and Traditional Ecological Knowledge Erosion in the Kashmir Himalayas. *Current Opinion in Environmental Sustainability*, 79, 101620. https://doi.org/10.1016/j.cosust.2026.101620
[105] Whyte, K., Talley, J. L., & Gibson, J. D. (2019). Indigenous Mobility Traditions, Colonialism, and the Anthropocene. *Mobilities*, 14(3), 319–335. https://doi.org/10.1080/17450101.2019.1611015

permanent locations changed the conditions under which communities could maintain established practices.

In Alaska, for example, colonial and state interventions contributed to changes in settlement patterns and access to services. Schools, administrative institutions and other public facilities could reinforce permanent residence in locations that did not necessarily correspond to earlier seasonal patterns. However, these histories vary between communities and cannot be reduced to a single transition from nomadism to settlement.

Whyte and colleagues argue that mobility should be understood in relation to Indigenous self-determination and the effects of colonial restrictions. This perspective is relevant to TEOS 2100 because it demonstrates that the ability to move is shaped by political authority. Mobility can be supported or constrained through land rights, borders, public institutions and access to essential services.

The historical experience also cautions against assuming that settlement or mobility is inherently more desirable. For some communities, the ability to remain on ancestral land is central to cultural continuity. For others, access to established routes and seasonal movement is essential. A future system that promotes mobility without protecting the right to remain could reproduce forms of displacement rather than enable adaptation.

Mobility, land rights and institutional membership

The examples discussed in Chapter 4.4 show that secure access to resources does not necessarily require exclusive individual ownership. The Amazigh Agdal system regulates access to grazing resources through customary institutions and seasonal rules. The historical Allmende of Southern Germany and Switzerland demonstrates how settled communities combined individual property with collectively managed land and resource use.

These arrangements developed in different contexts, but both illustrate how access can be governed through recognised rights rather than unrestricted occupation. The relationship between such systems and mobile societies deserves consideration. A household moving between locations may require access to grazing land, housing, water or other services without intending to acquire permanent ownership.

In established pastoral systems, recurring access rights can support such movement. In contemporary urban systems, access may instead depend on rental agreements, administrative registration and market conditions. The institutional principles differ, but both concern the relationship between residence and recognised rights. For TEOS 2100, a possible future direction is the development of arrangements in which access to essential resources remains secure across changes in residence.

This would require mechanisms for identifying legitimate claims, determining responsibilities and resolving disputes between existing users and newcomers. The historical examples do not provide a ready-made solution. Customary systems may restrict access according to inherited membership. Urban housing systems may favour property owners or established residents. Both can create barriers to people who move. The relevant institutional question is therefore how rights can remain secure while accommodating changing patterns of membership and residence.

From migration to mobile social organisation

Migration and mobile social organisation are related but distinct. Migration describes movement involving a change in habitual residence. A mobile society is characterised by social and institutional arrangements in which movement forms a regular and recognised part of economic or communal life. An individual can migrate without becoming part of a mobile society. A household displaced by flooding may move once, settle permanently elsewhere and establish long-term connections to its new location.

Conversely, households that practise seasonal movement or maintain several residences may remain strongly connected to established communities. Mobility does not necessarily imply the absence of settlement. For TEOS 2100, the potential emergence of mobile societies refers to the possibility that movement becomes more systematically incorporated into the organisation of livelihoods and public institutions.

Such arrangements could take different forms. Some households may maintain a primary residence while periodically relocating for employment or access to resources. Others may distribute their economic activities across several regions and maintain relationships with multiple local communities. In more severe circumstances, repeated displacement may make long-term residence uncertain. However, involuntary movement under precarious conditions should not be confused with an established and secure system of mobility.

A society in which people are repeatedly displaced without reliable access to housing, services or legal protection is not necessarily an example of successful post-settlement adaptation. The distinction between mobility and insecurity is fundamental.

The emergence of multi-local livelihoods

Multi-local living provides a possible intermediate form between conventional permanent settlement and more extensive mobility. Households may maintain connections to several locations for employment, education, family obligations or access to resources. Different household members may reside in different places, or individuals may move periodically between locations.

Such arrangements already exist in many regions. Seasonal labour migration, circular migration and transnational households demonstrate that economic and social participation need not be confined to one place of residence. The environmental pressures considered in TEOS 2100 could increase the relevance of such arrangements.

Where agricultural livelihoods become less reliable, households may seek additional income elsewhere while maintaining their original homes. Where repeated hazards make residence temporarily unsafe, people may require access to alternative accommodation. In receiving regions, more variable patterns of residence may increase demand for flexible housing and service provision. However, multi-local living can create costs and inequalities.

Maintaining access to more than one location may require financial resources that poorer households do not possess. Mobility can also separate family members, increase care burdens or expose workers to insecure employment. Its contribution to adaptation therefore depends on the availability of legal protections, affordable transport and reliable services.

For TEOS 2100, multi-locality offers a plausible field for institutional development rather than a universal model of future living.

The role of governance in enabling mobility

The movement of people does not automatically create institutions capable of supporting them. Existing public systems often determine access to services through permanent residence, citizenship, local registration or employment status. These arrangements can become difficult to navigate when individuals move frequently or maintain connections to several jurisdictions.

A household may be entitled to healthcare in one location but face administrative barriers elsewhere. Children who move between places may experience disruptions to education. Workers may lose access to social protection when employment or residence changes. Housing rights can also be uncertain where temporary occupancy is poorly regulated.

The *World Migration Report 2026* published by the International Organization for Migration examines the need to connect climate mobility with local development, disaster risk reduction, social protection and migration governance. Its chapter on local and community action emphasises the importance of institutions that understand the different circumstances of affected populations.[106]

The report identifies the limitations of reactive approaches that respond to movement mainly after disasters have occurred. For TEOS 2100, this provides a practical foundation for examining more anticipatory arrangements. These may include improved coordination between local authorities, recognition of mobile livelihoods and mechanisms that allow people to maintain access to services across locations.

However, institutional flexibility must be combined with the protection of rights. Systems designed to manage mobility should not create new restrictions on movement or reduce the political participation of people who are temporarily absent. The relevant objective is to preserve legal and social security despite changing patterns of residence.

Mobility and the right to remain

The possibility of more mobile societies must be considered alongside the rights and preferences of people who wish to remain in their existing communities. Not all movement is voluntary. Environmental hazards, loss of livelihoods or inadequate public support may leave households with limited alternatives.

Relocation can reduce exposure to certain risks while creating new vulnerabilities associated with housing, employment and social integration. The ability to move safely is therefore only one aspect of adaptation. The ability to remain, where continued residence can be supported, is also important. This distinction is emphasised in research on Indigenous

[106] Narusova-Schmidt, A., & Lincango, M. (2026). Addressing Climate Mobility: The Role of Local and Community Action. In M. McAuliffe & P. Ceriani Cernadas (Eds.), *World Migration Report 2026*, Chapter 6. Geneva: International Organization for Migration. https://publications.iom.int/books/world-migration-report-2026-chapter-6

mobility and climate justice. Mobility and immobility are not opposing indicators of adaptation success or failure.

Their significance depends on the choices available to affected people and the conditions under which decisions are made. For TEOS 2100, a post-settlement perspective should therefore avoid treating permanent residence as obsolete. The potential development of more mobile institutions should expand the available range of secure living arrangements. It should not establish mobility as a requirement imposed on people whose settlements face environmental pressures.

Mobile societies under a contraction of viable settlement space

The hypothesis of a contraction of viable settlement space provides a possible mechanism through which more mobile forms of social organisation could gain relevance. Where some locations progressively lose the ability to support existing livelihoods and essential services, people may seek opportunities elsewhere. Receiving regions may face increasing population demand and competition over resources.

If secure permanent residence becomes difficult to obtain in these regions, households may turn to temporary accommodation or distribute their activities across several locations. Some forms of movement may become recurrent rather than exceptional. Under these circumstances, institutions may face pressure to accommodate people who cannot be adequately described as permanent residents of a single place. However, this development is not inevitable.

Effective adaptation may allow many settlements to remain viable. Public investment and changes in economic activity may enable receiving regions to accommodate population growth. Mobility may also decline where employment opportunities become concentrated in stable urban centres. The emergence of mobile societies therefore depends on environmental conditions, economic incentives, legal arrangements and collective decisions.

For TEOS 2100, the hypothesis is not that environmental change will recreate historical nomadic societies. It is that the organisation of residence and public services may become more flexible as population movements and environmental pressures challenge existing settlement arrangements.

Implications for TEOS 2100

Existing mobile societies demonstrate that livelihoods and social relationships can be organised across different locations. Himalayan pastoralism provides examples of seasonal mobility supported by customary knowledge and access arrangements. Indigenous mobility traditions show how movement can be connected to cultural identity, territorial responsibilities and political self-determination.

Historical communal land-use systems, including the Allmende and Agdal discussed in Chapter 4.4, demonstrate that secure access to essential resources can be separated from exclusive individual ownership. These examples do not establish a single model for future societies. They show that the relationship between permanent residence, rights and economic organisation has varied across cultures and historical periods.

For TEOS 2100, this provides a foundation for examining institutional alternatives to systems that assume stable residence in one location. Environmental change may increase the demand for arrangements that support temporary movement, circular migration and multi-local livelihoods. Such arrangements could involve flexible housing, continued access to education and healthcare, coordinated social protection and recognition of legitimate rights across different jurisdictions. Their feasibility would depend on political choices, administrative capacity and the equitable distribution of costs.

More mobile societies would also face familiar difficulties. Access to land, housing and resources would remain contested. The distinction between established residents and newcomers could create tensions, particularly where rights depend on local membership. Institutions would therefore need mechanisms for participation, resource allocation and dispute resolution that accommodate different patterns of residence.

A *Post-Settlement Civilisation* should not be understood as a world without settlements. It describes a possible form of social organisation in which permanent attachment to one location becomes less decisive for access to rights, public services and economic participation. The emergence of such a civilisation is neither a necessary nor an established consequence of climate change.

It is a foresight proposition developed from the interaction of environmental pressures, settlement viability, migration and institutional responses examined in this report. The following chapter considers what forms of governance and public provision might support such arrangements.

5. Building a Post-Settlement Civilisation

5.1 Governance, Sovereignty, and Conflict Resolution

The political institutions of contemporary societies are closely connected to territory. States exercise jurisdiction within recognised boundaries, provide public services through territorial administrations and organise political representation around populations associated with particular places.

Mobility does not remove these relationships. People have always migrated, maintained connections across borders and participated in economic and political life beyond their places of origin. However, the environmental pressures examined in this report may increase the significance of these arrangements.

Some households may maintain livelihoods in several locations. Others may relocate permanently when existing settlements become unsafe or economically untenable. Communities may remain socially connected even when their members are dispersed across different jurisdictions.

Under such conditions, governance must address more than the movement of people. It must determine how rights are maintained, how responsibilities are distributed and how individuals participate in decisions affecting their lives. These questions become more difficult where the relationship between population and territory changes substantially. They become more fundamental still where an existing state's territory is no longer capable of supporting permanent habitation.

For TEOS 2100, the central issue is therefore not whether territorial governance will disappear. There is little basis for assuming that it will. The question is how existing institutions could adapt to populations whose political, economic and social lives increasingly extend beyond one place.

Governance as a condition of mobility

Environmental change does not determine migration outcomes independently of political and economic institutions. Households respond to environmental pressures according to their resources, employment opportunities, social relationships and the legal conditions under which movement is possible. A family may remain in an exposed location because it possesses the means to adapt. Another may relocate because the costs of remaining have become excessive. Some people may wish to move but lack the resources or permission to do so.

The UK Government Office for Science report *Migration and Global Environmental Change* identified migration as a process shaped by several interacting drivers, including environmental conditions, economic circumstances and public policy. It also drew attention to populations unable to move despite exposure to environmental risks.[107]

[107] Foresight (2011). *Migration and Global Environmental Change: Future Challenges and Opportunities*. Final Project Report. London: Government Office for Science.

These findings are relevant to the governance of a possible Post-Settlement Civilisation. Policies concerning residence, employment, land and public services can expand or restrict the choices available to individuals. Migration may support adaptation when movement is voluntary, safe and accompanied by opportunities to maintain livelihoods. It may create additional insecurity when individuals lose legal status, access to employment or essential services. Lindegaard and colleagues have argued for examining climate-related mobilities through the institutions and political processes that shape movement and its consequences.[108]

This approach shifts attention from migration as an isolated response to environmental change towards governance as a determining factor in human outcomes. For TEOS 2100, it means that mobility should not be treated solely as a transport or population-distribution problem. It is also a question of political membership, public responsibilities and the allocation of rights.

Sovereignty and territorial jurisdiction

Modern international law recognises sovereign states as principal actors in international relations. Article 1 of the 1933 Montevideo Convention on the Rights and Duties of States identifies four commonly referenced qualifications for statehood: a permanent population, a defined territory, government and the capacity to enter into relations with other states.[109]

These criteria help explain why territory remains significant in international governance. However, their application does not mean that every change in territory or population automatically ends the existence of an established state. The distinction between establishing a new state and preserving the legal identity of an existing state is fundamental.

State sovereignty also extends beyond complete freedom of unilateral action. States undertake obligations through treaties and customary international law. They participate in international institutions and may accept procedures for resolving disputes or coordinating activities across borders.

For the Hindu Kush Himalayan region, sovereignty remains relevant to the governance of water, land, infrastructure and population movement. River systems cross national boundaries, while the consequences of infrastructure projects may extend beyond the jurisdiction in which they are constructed. Countries therefore face problems that cannot always be addressed effectively through domestic administration alone.

Governance under changing settlement conditions may require stronger cooperation without eliminating national sovereignty. The institutional challenge is to determine where responsibilities remain national and where coordination becomes necessary.

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https://www.gov.uk/government/publications/migration-and-global-environmental-change-future-challenges-and-opportunities

[108] Lindegaard, L. S., Webster, N., Sørensen, N. N., & Borderon, M. (2024). Introduction to the Special Section: Unfolding a Governance Perspective on Climate-Related Mobilities. *Climate and Development*. https://doi.org/10.1080/17565529.2024.2379464

[109] Convention on the Rights and Duties of States (Montevideo Convention), 26 December 1933, Article 1. Text reproduced by the University of Oslo Faculty of Law. https://www.jus.uio.no/english/services/library/treaties/01/1-02/rights-duties-states.html

Statehood when territory becomes uninhabitable

Climate-related sea-level rise has raised a legal question that was previously discussed largely as a hypothetical possibility. What happens to the sovereignty and international legal personality of an existing state if its territory becomes permanently uninhabitable or, in an extreme case, is submerged?

This problem differs from the environmental pressures facing the Hindu Kush Himalayan region. Mountain settlements may become difficult or unsafe to inhabit while the territorial existence of the states concerned remains intact. Low-lying island states face a more direct question about the physical conditions underpinning territorial sovereignty.

Nevertheless, the legal developments concerning sea-level rise are relevant to TEOS 2100 because they address the relationship between statehood, population and territory. The Pacific Islands Forum adopted its *Declaration on the Continuity of Statehood and the Protection of Persons in the Face of Climate Change-related Sea-Level Rise* in 2023. The declaration affirms that the statehood and sovereignty of its members should continue notwithstanding the effects of climate-related sea-level rise.[110]

In September 2024, the Alliance of Small Island States adopted a further declaration affirming the continuity of statehood and membership in international organisations despite such impacts.[111]

These positions reflect the interests and legal views of states facing substantial environmental risks. They have also contributed to wider international legal discussion. The International Law Commission completed its work on sea-level rise in relation to international law in 2025. Its final report identified strong support among states for preserving the sovereignty and international legal personality of states affected by sea-level rise. It distinguished continuity of existing statehood from the ordinary criteria applied to the emergence of new states.[112]

The International Court of Justice addressed the question in its advisory opinion of 23 July 2025 on the obligations of states in respect of climate change. The Court concluded that the disappearance of one of the constituent elements of an already established state would not necessarily entail the loss of its statehood. It also emphasised the obligation of states to cooperate in addressing the consequences of sea-level rise.[113]

On 20 May 2026, the United Nations General Assembly adopted Resolution A/RES/80/263.

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[110] Pacific Islands Forum (2023). *Declaration on the Continuity of Statehood and the Protection of Persons in the Face of Climate Change-related Sea-Level Rise*. https://forumsec.org/sites/default/files/2024-05/2023%20Declaration%20on%20the%20Continuity%20of%20Statehood%20and%20the%20Protection%20of%20Persons.pdf

[111] Alliance of Small Island States (AOSIS) (2024). *AOSIS Leaders Declaration on Sea Level Rise and Statehood*, agreed 23 September 2024. https://aosis.org/document/doc.aosis-leaders-declaration-on-sea-level-rise-and-statehood/

[112] International Law Commission (2025). *Report of the International Law Commission on the Work of Its Seventy-sixth Session*, A/80/10, Chapter IV and Annex I: Final Report of the Study Group on Sea-Level Rise in Relation to International Law. https://legal.un.org/ilc/reports/2025/

[113] International Court of Justice (2025). *Obligations of States in Respect of Climate Change*. Advisory Opinion of 23 July 2025, paragraphs 363–365. https://www.icj-cij.org/case/187

The resolution welcomed the Court's advisory opinion and affirmed the continuity of statehood in the face of sea-level rise.[114]

These developments substantially strengthen the legal and political position supporting the continued existence of affected states. They do not, however, resolve all questions concerning the practical exercise of sovereignty where a population lives permanently outside its original territory.

Preserving an existing state is not the same as creating a new one

An important distinction must be maintained between the continuity of an existing state and the possible emergence of political communities organised without territorial sovereignty. A state whose population has been displaced by sea-level rise may retain international legal personality under the developing principles described above. Its government may continue representing the state internationally, subject to the relevant constitutional and legal arrangements.

A newly formed transnational community of mobile workers or displaced households would not automatically possess the same status. The United Nations Charter provides for membership by states. Under Article 4, the admission of a new member requires a recommendation from the Security Council and a decision by the General Assembly.[115]

The United Nations does not possess a general procedure for granting statehood or full membership to communities solely because they share a mobile way of life. Nor should the legal continuity of an existing state be interpreted as establishing a general right for newly created non-territorial entities to exercise sovereign powers.

For TEOS 2100, this distinction limits the extent to which future governance models can be presented as developments already supported by international law. Mobile communities may establish representative associations, cooperative institutions and transnational organisations. They may participate in recognised public consultations or negotiate arrangements with existing governments.

Such institutions can exercise responsibilities without necessarily becoming sovereign states. The practical development of these arrangements remains open to political and legal innovation.

The continued role of the United Nations

International organisations already provide mechanisms for cooperation between states. The United Nations supports international negotiations, establishes forums for addressing shared problems and develops principles concerning human rights and interstate relations. However, it does not function as a general government with authority to replace domestic political institutions. Its ability to create and enforce obligations depends on the United

[114] United Nations General Assembly (2026). *Advisory Opinion of the International Court of Justice on the Obligations of States in Respect of Climate Change*. Resolution A/RES/80/263, adopted 20 May 2026, operative paragraph 7. https://digitallibrary.un.org/record/4118331
[115] United Nations (1945). *Charter of the United Nations*, Article 4. https://www.un.org/en/about-us/un-charter/chapter-2

Nations Charter, applicable international law and the commitments of member states.

In the context of climate-related mobility, the United Nations may contribute through legal clarification, international cooperation, technical assistance and coordination between governments. It may also provide forums in which states negotiate shared responsibilities concerning displacement and the protection of affected populations. Nevertheless, an internationally coordinated system of mobility rights would require political agreement and implementation by participating states.

The United Nations cannot simply require all countries to admit people relocating because of environmental deterioration. Similarly, it cannot automatically confer voting rights or citizenship on mobile populations. These limitations make regional and bilateral cooperation important. They also demonstrate why political representation cannot be reduced to the existence of international institutions.

People must be able to influence decisions made by the authorities that exercise power over their lives.

Citizenship and the portability of rights

Citizenship establishes a continuing legal relationship between individuals and states. Many citizens retain their nationality after moving abroad. Some countries also permit citizens living outside their territory to vote in national elections, receive consular assistance or maintain other legal connections. These arrangements provide existing examples of political membership extending beyond residence.

Collyer examined the development of extraterritorial citizenship and external voting, demonstrating that states have adopted different approaches to political participation by citizens abroad.[116]

However, legal continuity does not guarantee equal access to rights. A person may retain citizenship in one country while living and working in another. Their access to education, healthcare, employment or social benefits may depend on agreements between the relevant jurisdictions.

The European Union provides an example of the coordination of social security systems across national boundaries. Regulation (EC) No 883/2004 establishes rules addressing the application of national legislation, equal treatment and the coordination of certain benefits for people moving within its scope.[117] It does not replace national social protection systems with a single European system.

For TEOS 2100, the significance of such arrangements lies in demonstrating how rights can be coordinated without dissolving existing states. However, the portability of social benefits and the portability of political rights are different questions. A person may retain pension

[116] Collyer, M. (2014). A Geography of Extra-Territorial Citizenship: Explanations of External Voting. *Migration Studies*, 2(1), 55–72. https://doi.org/10.1093/migration/mns008

[117] European Parliament and Council of the European Union (2004). *Regulation (EC) No 883/2004 on the Coordination of Social Security Systems*, as amended. https://eur-lex.europa.eu/eli/reg/2004/883/oj

entitlements across borders while lacking the right to vote in the municipality where they live. The next institutional challenge is therefore democratic representation.

Democratic participation beyond territory

Political participation is usually organised through citizenship, residence and electoral districts. These arrangements assume a relationship between the people represented and the territory governed. Permanent or repeated mobility can complicate that relationship. A person may be a citizen of one country, reside in another and work periodically in a third. They may be subject to public decisions made in several jurisdictions. Their children may attend school in one location while their pension contributions are recorded elsewhere.

The political consequences of these arrangements are not adequately addressed by mobility rights alone. Article 25 of the International Covenant on Civil and Political Rights recognises the right of citizens to participate in public affairs, vote and stand for election, subject to the requirements and limitations established by international human rights law. The United Nations Human Rights Committee's General Comment No. 25 interprets participation in public affairs broadly, encompassing political authority and the development and implementation of policy at different levels of government. It also recognises participation through elected representatives, public debate and certain forms of direct involvement.[118]

The citizenship-based formulation of Article 25 creates a continuing challenge for populations living outside their country of nationality. Political participation may remain possible in the country of origin while being restricted in the receiving state. The result can be a separation between those who exercise political authority and those who are substantially affected by its decisions.

Voting from abroad: formal rights and practical access

External voting already demonstrates that political participation need not always require physical presence within national territory. Countries use several approaches, including voting at diplomatic missions, postal voting and, in some cases, electronic systems. They also differ in how votes cast abroad are incorporated into electoral representation. Some assign non-resident citizens to constituencies associated with their previous residence. Others provide separate representation for citizens living abroad.

International IDEA's *The Global State of Democracy 2025: Democracy on the Move* examines these arrangements and the differences between formal electoral rights and effective participation. The report identifies administrative obstacles, registration requirements and practical access to voting as continuing concerns. It also documents substantial variation in the political significance of votes cast abroad.[119]

For TEOS 2100, these findings are relevant because larger and more permanently

[118] United Nations (1966). *International Covenant on Civil and Political Rights*, Article 25; United Nations Human Rights Committee (1996), *General Comment No. 25*, paragraphs 5–8. https://www.ohchr.org/en/instruments-mechanisms/instruments/international-covenant-civil-and-political-rights

[119] International IDEA (2025). *The Global State of Democracy 2025: Democracy on the Move*. Stockholm: International IDEA. https://doi.org/10.31752/idea.2025.53

dispersed populations could place additional demands on electoral institutions. A government representing citizens living in several countries would need procedures for maintaining electoral registers, preventing duplicate voting and ensuring the secrecy and integrity of elections. Citizens would need accessible information and realistic opportunities to participate.

Different voting methods involve trade-offs. In-person voting may be difficult for citizens living far from diplomatic missions. Postal voting depends on reliable delivery arrangements. Online voting may improve geographical accessibility but introduces risks involving cybersecurity, coercion, unequal digital access and confidence in electoral integrity. Digital identity alone does not resolve these problems. An electoral system is legitimate only if people can participate under fair conditions and trust that votes are recorded and counted appropriately.

Three dimensions of political belonging

For TEOS 2100, political participation under conditions of extensive mobility can be examined through three overlapping relationships.

Citizenship connects individuals to a state through nationality and associated political rights.

Residence connects individuals to the public institutions governing the place in which they live.

Affectedness concerns the consequences of decisions for people who may neither be citizens nor residents of the jurisdiction making them.

These relationships frequently overlap in settled societies. They may become more distinct where people move between locations or depend on resources managed beyond their place of residence.

A citizen may wish to participate in elections in their country of origin while also seeking a voice in local decisions concerning housing, water or education in a receiving municipality. A seasonal worker may spend much of the year in a region without acquiring the residence status required for local political participation. An agricultural community may depend on river flows affected by decisions made far upstream in another country.

The third situation illustrates an important boundary of territorial democracy. People may be directly affected by decisions over which they possess little formal political influence. These circumstances do not necessarily justify identical voting rights in every jurisdiction.

However, they raise questions about the adequacy of participation mechanisms based exclusively on citizenship and permanent residence. TEOS 2100 uses citizenship, residence and affectedness as analytical dimensions rather than as a proposed replacement for existing constitutional systems.

Participation in receiving communities

Long-term residents who lack citizenship may contribute to the economy and depend on public services without enjoying the full political rights available to citizens. The resulting gap

becomes more significant where migration is sustained or circular.

A family may live in a municipality for years while maintaining legal nationality elsewhere. Its members may be affected by decisions concerning housing, schooling, public transport and local resource allocation. Their opportunities for political participation depend on the laws of the receiving jurisdiction. Some countries allow certain categories of non-citizens to vote in local elections. Others restrict electoral participation to citizens while providing consultation mechanisms or representation through community organisations.

For TEOS 2100, the relevant issue is not whether national citizenship should disappear. It is whether institutions can provide meaningful participation to people who form part of a community's social and economic life. Possible approaches include local consultation rights, participatory planning procedures and arrangements for representation in particular public bodies. In some jurisdictions, extending local voting rights to long-term residents could also be considered.

These options would require legal and constitutional decisions. They should not be presented as rights already established universally under international law. Participation also requires practical accessibility. People who work irregular hours, move seasonally or lack reliable digital access may be formally invited to participate while remaining unable to do so.

Public authorities therefore need to consider who can attend, receive information and influence decisions before those decisions are finalised.

Political authority when a state has no habitable territory

The continuity of statehood discussed earlier creates a further democratic problem. An existing state may retain sovereignty and international legal personality even when its population can no longer live permanently within its original territory. Yet the preservation of statehood does not establish how political representation will function. If citizens reside across several host countries, the state may need mechanisms for maintaining electoral registers and determining eligibility for public office.

Its institutions may require arrangements for meeting, administering services and exercising functions outside the original territory. Constitutional provisions concerning electoral districts, residence requirements and local government may need revision. Questions of taxation and public finance would also arise. A government whose citizens earn income in several countries may face difficulties financing public responsibilities through conventional territorial tax systems.

At the same time, host states would continue exercising jurisdiction over the people residing within their boundaries. A dispersed population could therefore maintain political membership in its original state while being subject to public authority in other states. This is not necessarily a contradiction. Citizenship and residence already create overlapping legal relationships. However, the scale and permanence of displacement could make existing arrangements insufficient.

For TEOS 2100, the key question is how a continuing state could remain democratically accountable to its population without assuming that territorial residence remains the basis of political representation. Possible responses include dedicated representation for citizens

abroad, revised electoral districts and accessible methods of political participation. Such mechanisms would require constitutional legitimacy and reliable administration.

The continuation of statehood is a necessary starting point for this discussion, not its conclusion.

Political communities without sovereignty

Not every mobile population belongs to a state whose territory has become uninhabitable. Some communities may consist of individuals holding different nationalities and maintaining livelihoods across several countries. They may establish institutions responsible for education, mutual assistance, professional standards or the management of common resources. These organisations can represent interests and negotiate with public authorities.

However, they do not automatically acquire the sovereign powers of states. Their legitimacy depends on the authority granted by their members, applicable law and any agreements with public institutions. For TEOS 2100, such organisations may provide forms of representation where the needs of mobile populations are inadequately addressed through territorial institutions.

Yet they could also reproduce inequalities. A professional network may represent highly qualified workers while excluding people undertaking informal or unpaid work. A community association may favour established members over newcomers. The existence of representative bodies therefore does not establish democratic accountability. Their membership rules, decision-making procedures and means of resolving disputes require examination.

Decision-making across ecological boundaries

The governance of shared environmental resources reveals another limitation of strictly territorial participation. River systems connect upstream and downstream communities. Water withdrawals, hydropower development and land-use decisions may produce consequences beyond the jurisdiction in which they occur.

The 1997 United Nations Convention on the Law of the Non-Navigational Uses of International Watercourses establishes principles concerning equitable and reasonable utilisation, cooperation and the prevention of significant harm. Its provisions require consideration of relevant circumstances, including the needs of populations dependent on an international watercourse and the effects of uses in one state on others.[120]

These principles concern the rights and obligations of states. They do not automatically grant individuals in downstream communities voting rights over decisions taken upstream. Nevertheless, they demonstrate that the effects of resource use beyond national boundaries are already recognised within international legal frameworks.

Public participation provides a further dimension. The Aarhus Convention establishes

[120] United Nations (1997). *Convention on the Law of the Non-Navigational Uses of International Watercourses*, Articles 5–7. Adopted by General Assembly Resolution 51/229. https://treaties.un.org/pages/ViewDetails.aspx?src=TREATY&mtdsg_no=XXVII-12&chapter=27

obligations concerning access to environmental information, public participation in certain environmental decisions and access to justice for parties within its scope. It provides a legal example of participation extending beyond periodic elections.[121] For the Hindu Kush Himalayan region, these instruments are relevant as institutional references, not as evidence that every state in the region is bound by the same treaty obligations.

TEOS 2100 does not propose that affected downstream populations should automatically possess equal voting rights in upstream municipalities. Instead, it raises the question of how decisions with transboundary effects can include information, consultation and accountability beyond the immediate jurisdiction.

Participation according to affectedness

The principle of affectedness offers a way to examine who should have a voice in decisions extending beyond territorial boundaries. A proposed water diversion may affect farmers downstream. A regional mobility agreement may influence housing demand in receiving municipalities. An infrastructure investment may improve services for one population while restricting access to resources for another.

In each case, the people affected may not be identical to the people formally represented by the deciding authority. A governance system could respond through several levels of participation. Affected populations might receive timely information and opportunities to present evidence. They could be represented through consultative bodies or joint committees.

Where jurisdictions share responsibilities, formal agreements could provide for negotiated decision-making and review. In other circumstances, administrative or judicial remedies may be appropriate. These arrangements differ from an unrestricted right for every affected person to vote on every decision. Such a model would raise difficult questions concerning the identification of affected populations, the relative significance of different impacts and the accountability of decision-makers.

The challenge is to develop participation mechanisms proportionate to the authority exercised and the consequences of decisions. The United Nations General Assembly's Resolution A/RES/80/263 of May 2026 calls for the full, meaningful and equal participation of specified affected groups in climate action, where appropriate, including through access to information and justice.[122]

This provides a contemporary international reference for meaningful involvement. It does not establish a universal system of transboundary voting rights. For TEOS 2100, the question is how such principles might inform institutions operating across increasingly mobile populations and interconnected resource systems.

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[121] United Nations Economic Commission for Europe (1998). *Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters* (Aarhus Convention), Articles 6–9. https://unece.org/environment-policy/public-participation/aarhus-convention/text

[122] United Nations General Assembly (2026). Resolution A/RES/80/263, adopted 20 May 2026, operative paragraph 5 on participation in climate action. https://digitallibrary.un.org/record/4118331

Democratic accountability in digital networks

Economic coordination may extend beyond states through private digital platforms. Such systems can facilitate employment, financial transactions, access to services and the verification of qualifications. They may also determine eligibility, allocate assignments or restrict participation through commercial rules. Chapter 5.6 examines the technical opportunities and risks associated with these arrangements.

From a governance perspective, the concern is accountability. People may depend on a platform for essential economic opportunities without possessing effective means of influencing its rules or challenging decisions. Commercial membership differs from citizenship. Private organisations operate within legal frameworks, but their internal decision-making is not necessarily democratic.

For TEOS 2100, the emergence of extensive private networks raises questions about which decisions should remain subject to public oversight. Where access to employment or essential services depends on private systems, transparent procedures and effective remedies may be necessary. Labour representation, contractual protections and public regulation can address some of these concerns.

However, the international reach of digital networks can complicate enforcement. A worker may live in one country, perform assignments in another and depend on a platform headquartered elsewhere. The resulting uncertainty resembles problems encountered in the coordination of social protection and migration rights.

It also demonstrates that political participation cannot be considered independently of economic power.

Digital participation: possibilities and limits

Digital technologies could support political participation by people living far from their countries of origin or moving between jurisdictions. They can facilitate communication with elected representatives, access to public information and participation in consultations. Some electoral systems have introduced electronic methods for citizens voting from abroad.

However, digital participation introduces risks involving authentication, privacy, unequal access and security. Political freedom also requires protection against coercion and surveillance. A person should not have to surrender private information about movements, employment or political preferences merely to exercise a recognised right. This is relevant where digital identity systems are used to coordinate access to services.

The same infrastructure that enables administrative continuity can allow authorities or private providers to monitor individuals across locations. Democratic participation therefore requires more than technical connectivity. It depends on legal safeguards, independent oversight and institutions capable of responding to complaints.

Digital methods may expand access, but they should not become the sole means through which people can participate. Individuals without reliable connectivity or technical skills must not be excluded from decisions affecting their lives.

Conflict resolution in mobile and shared-resource societies

Mobility and resource interdependence can generate disputes that extend beyond conventional administrative boundaries. A disagreement over water may involve several communities and public authorities. A mobile worker may face an employment dispute involving different legal jurisdictions. A household relocating under a bilateral agreement may encounter conflicting decisions concerning residence, education or social benefits.

These conflicts are not necessarily indications of institutional failure. They arise because interests and responsibilities overlap. The effectiveness of governance depends partly on whether disputes can be addressed through accessible and recognised procedures. The World Bank's research on social cohesion and forced displacement identifies the influence of institutions, public services and relationships between host populations and displaced communities on social outcomes.[123]

For TEOS 2100, conflict-resolution mechanisms should therefore be examined alongside the formal distribution of rights. Administrative review, mediation and judicial procedures may each have roles. In shared-resource systems, local agreements and independent review can help address disputes concerning allocation. International arrangements may establish consultation and dispute-settlement procedures between states.

However, mechanisms effective for governments may remain inaccessible to individuals. A mobile person may lack the resources to pursue a complaint across several jurisdictions. A community may be consulted but possess no means of challenging a decision that ignores its interests. Governance requires procedures through which rights and responsibilities can be contested in practice.

Local institutions and the management of shared resources

Historical and contemporary forms of communal resource management demonstrate that institutions need not rely exclusively on central state allocation or individual ownership. Chapter 4.4 examined the Agdal and Allmende systems as examples of arrangements through which communities regulate resource use. Elinor Ostrom's research on common-pool resources provides a framework for understanding how such institutions can function. Her work identifies the importance of rules adapted to local conditions, participation by resource users, monitoring and accessible conflict-resolution procedures.[124]

These principles are relevant to the management of water, land and other shared resources under changing settlement conditions. However, collective governance can also generate exclusion. Membership may depend on inheritance, property ownership or long-standing residence. Newcomers may contribute economically without obtaining recognised rights. An institution may remain effective for established members while failing to accommodate changing population patterns.

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[123] World Bank (2023). *Social Cohesion and Forced Displacement: A Synthesis of New Research*. Washington, DC: World Bank. https://documents.worldbank.org/en/publication/documents-reports/documentdetail/099500006092317098

[124] Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511807763

For TEOS 2100, local resource governance should therefore be assessed according to both its capacity to manage resources and the opportunities it provides for participation. This requires attention to the rights of established users, the claims of new participants and the physical limits of the resource system. The problem becomes more complex where environmental pressures require repeated adjustments to allocations.

Polycentric governance and shared responsibilities

Governance under changing settlement conditions may involve several centres of decision-making. Local institutions can manage particular resources and services. Municipalities can coordinate housing and public infrastructure. National governments retain responsibilities concerning legislation, citizenship and public finance. Regional organisations may address migration agreements and shared ecological systems. International institutions provide frameworks for cooperation and the clarification of legal obligations.

Such arrangements resemble the concept of polycentric governance developed in institutional research. Multiple centres of authority can allow decisions to reflect local conditions while larger institutions coordinate responsibilities extending across jurisdictions. However, institutional diversity does not automatically produce effective governance. Responsibilities may overlap or remain undefined.

Differences in financial capacity can limit implementation. People may find it difficult to determine which authority is responsible for a particular problem. For TEOS 2100, polycentric governance is therefore an analytical possibility rather than a guaranteed solution. Its effectiveness depends on clear responsibilities, procedures for cooperation and the ability of affected people to identify and challenge relevant decisions.

Democratic accountability must remain visible across the different levels.

Financing rights across jurisdictions

Political commitments require administrative and financial capacity. A mobility agreement may establish residence rights while leaving receiving municipalities responsible for housing, education and healthcare. A state with a widely dispersed population may retain obligations to its citizens while collecting much of its public revenue from activities outside its remaining territory. Regional resource-management institutions may require contributions from several governments and communities.

These arrangements raise questions about taxation, public expenditure and accountability. People may contribute economically to one jurisdiction while receiving benefits from another. Such situations are not entirely new. International labour migration and social security coordination already create overlapping responsibilities. However, more extensive and permanent mobility could increase their significance.

For TEOS 2100, governance arrangements should specify not only which rights are recognised but also which institutions are responsible for implementing and financing them. The allocation of financial responsibilities can become a source of conflict where states or municipalities perceive their obligations as unequal.

Transparent financing arrangements and opportunities for public scrutiny are therefore

relevant to political legitimacy.

A framework for governance under changing settlement conditions

The preceding analysis suggests that governance in a possible Post-Settlement Civilisation cannot be reduced to one institutional model. Territorial states are likely to remain important. Their continued sovereignty can coexist with regional cooperation, mobile populations and organisations whose activities extend across borders. The legal developments concerning sea-level rise demonstrate that international law can adapt to profound changes in the relationship between territory and statehood. Yet legal continuity alone cannot guarantee democratic legitimacy or access to essential services.

For TEOS 2100, governance can be assessed through five connected questions.

- First, can individuals maintain recognised rights when their residence or employment changes?
- Second, are the responsibilities of relevant public and private institutions identifiable and enforceable?
- Third, can people participate in decisions affecting their lives, including when they live outside their country of citizenship or are affected by decisions made in another jurisdiction?
- Fourth, are arrangements for shared resources capable of addressing competing interests without systematically excluding particular groups?
- Fifth, do individuals and communities possess effective means of challenging decisions and resolving disputes?

These questions apply differently across the four futures developed in Chapter 6.

- *Fortress Earth* explores governance dominated by territorial protection and unequal access.
- *Negotiated Mobility* examines cooperation between sovereign states that expands recognised opportunities for movement.
- *Networked Nomads* considers extensive economic connectivity without comparable institutional protection.
- *Planetary Transition* explores coordinated adaptation and resource governance while retaining the possibility of conflicts over membership and allocation.

The Human Stories in Chapter 7 make these distinctions visible through individual decisions. They demonstrate that institutions may function effectively for some people while leaving others with limited influence over the conditions of their lives.

Implications for TEOS 2100

The long-term viability of human societies cannot be assessed solely through the durability of settlements or the capacity to move between them. It also depends on the institutions through which people exercise rights, participate in collective decisions and resolve conflicts.

A state may retain its international legal personality despite environmental changes affecting its territory. A person may retain citizenship while living outside the state of nationality. A community may manage shared resources through established rules while remaining

uncertain about the participation of new members. An international economic network may enable employment across several countries without providing comparable political or social protection.

These arrangements raise different questions, but they share an underlying concern. The relationship between the people subject to decisions and the institutions making those decisions can become increasingly fragmented. For TEOS 2100, democratic participation must therefore be considered a component of human viability. Access to water, housing, employment, education and healthcare is central to maintaining secure living conditions. So is the ability to influence the rules governing that access.

The future of governance under changing settlement conditions may involve new agreements, revised electoral systems and stronger institutions for managing shared resources. The forms these developments take cannot be predicted. What can be examined is whether they preserve meaningful rights and accountability as the relationship between population and territory changes.

A Post-Settlement Civilisation would not become politically legitimate merely by enabling people to move. Its institutions would also need to provide ways for people to belong, participate and exercise responsibility across the places that shape their lives.

5.2 Education

Education is closely connected to the institutions of permanent settlement. Schools generally serve defined geographical areas, maintain records of enrolled learners and organise teaching around relatively stable groups attending particular locations. These arrangements provide continuity for many children and families. However, they can create difficulties for people who move frequently or whose residence changes unexpectedly.

Climate-related disasters may interrupt schooling by damaging buildings, displacing households or disrupting transport and essential services. More gradual environmental changes may influence family livelihoods and lead to seasonal, temporary or permanent migration. The consequences for education depend on the circumstances of movement and the capacity of receiving institutions. Some learners may enter another school without substantial interruption. Others may encounter barriers related to documentation, language, costs, overcrowding or differences between education systems.

For TEOS 2100, the possible emergence of more mobile societies raises a broader question: how can education remain continuous when participation in learning is no longer consistently connected to residence in one location? The answer is not necessarily to replace schools with digital platforms or mobile classrooms. Existing institutions can provide stability, social relationships and educational support that are difficult to reproduce through remote learning alone. The challenge is to develop arrangements that allow education to remain accessible and coherent across different patterns of residence.[125]

Education as a right independent of permanent residence

[125] Park, J., & Yamaguchi, S. Y. (2025). *Integrating Data to Ensure Inclusive Education for Climate-displaced Populations*. UNU-IAS Policy Brief Series. United Nations University. https://unu.edu/publication/integrating-data-ensure-inclusive-education-climate-displaced-populations

The right to education provides the legal starting point for considering more mobile learning arrangements. Article 28 of the United Nations Convention on the Rights of the Child recognises the right of every child to education and requires states parties to make primary education compulsory and available free to all. Article 2 establishes the principle of non-discrimination for children within a state's jurisdiction, while Article 29 addresses educational development, human rights, cultural identity and respect for the natural environment.[126]

These provisions do not make a child's educational rights conditional on permanent residence in a particular municipality. However, the administrative arrangements through which education is delivered may still create barriers. School enrolment can depend on proof of residence, previous educational records, identity documents or other requirements established by national and local authorities. Children who move repeatedly may find it difficult to satisfy such requirements, particularly where displacement has caused the loss of documents or interrupted access to government services.

The distinction between a recognised right and the ability to exercise it is therefore important. UNESCO's *Strategic Framework for Migration, Displacement, Emergencies, and Education 2024-2029* identifies the need to protect education during crises and improve the inclusion of displaced populations within national education systems. The framework also recognises the importance of connecting humanitarian assistance with longer-term institutional development.[127] For TEOS 2100, these approaches provide a basis for examining educational rights that remain effective despite changes in residence. The institutional objective would be continuity of access rather than permanent attachment to one school.

Existing education systems for mobile populations

Mobile and pastoral communities already use different arrangements to provide children with formal education. These approaches developed in response to geographical distance, seasonal movement, economic activities and the limited availability of conventional school infrastructure.

Saverio Krätli's 2001 review of education provision to nomadic pastoralists examined the difficulties that arise when education systems are designed primarily around settled populations. He argued that the limited participation of pastoral communities in formal schooling should not be interpreted as evidence of limited knowledge or educational capacity. Pastoral livelihoods require extensive ecological knowledge, practical skills and complex forms of social organisation. The problem often lies in a mismatch between the structure of formal schooling and the conditions under which mobile communities live.[128]

[126] United Nations (1989). *Convention on the Rights of the Child*, Articles 2, 28 and 29. https://www.unicef.org/child-rights-convention/convention-text

[127] UNESCO (2025). *UNESCO Strategic Framework for Migration, Displacement, Emergencies, and Education 2024–2029: Protecting and Prioritizing Education in Times of Crisis*. Published 6 January 2025; updated 16 January 2026. https://www.unesco.org/en/articles/unesco-strategic-framework-migration-displacement-emergencies-and-education-2024-2029-protecting-and

[128] Krätli, S. (2001). *Education Provision to Nomadic Pastoralists: A Literature Review*. IDS Working Paper 126. Brighton: Institute of Development Studies. https://eric.ed.gov/?id=ED456957

Krätli therefore called for a broader understanding of education and more flexible approaches to its provision. These findings remain relevant to TEOS 2100. An education system that requires a family to abandon its livelihood or permanently relocate in order for children to attend school may improve access to formal qualifications while creating other economic and social costs. Flexibility must therefore concern more than the physical location of instruction. It also involves the timing of learning, the organisation of teaching, the recognition of existing knowledge and the relationship between educational institutions and communities.

Mobile classrooms and seasonal education

The UNESCO Global Education Monitoring Report has documented several approaches designed to accommodate children from mobile and remote communities. In Kyrgyzstan, pastoral households traditionally move to high-altitude grazing areas, known as *jailoo*, during the summer. These movements can overlap with programmes preparing children for entry into primary school. The *Jailoo Kindergartens* initiative, introduced in the Alai district in 2006, responded by offering early childhood education in seasonal grazing areas. According to the UNESCO GEM Report's 2021 account, more than 600 children attended 21 jailoo kindergartens during the 2018 grazing season. The programme also trained educators, parents and caregivers.[129]

Mongolia provides another example. Mobile *ger* kindergartens have been used to reach children from herding families living far from permanent educational facilities. These programmes may operate in traditional portable dwellings transported to remote locations for several weeks during the summer. They are connected to established kindergartens and provide structured early childhood education where conventional attendance would be difficult.

In Uzbekistan, mobile preschool programmes have used specially equipped buses and outdoor learning spaces to serve children in remote areas. The programmes have combined face-to-face activities with television and online teaching. These examples demonstrate that education can be delivered through different locations and formats. However, they do not establish that mobile classrooms are appropriate for every educational level.

Early childhood programmes, primary schooling, secondary education and vocational training have different requirements concerning teaching, assessment, safeguarding and specialised facilities. For TEOS 2100, the value of these approaches lies in demonstrating that educational institutions can adapt their delivery arrangements to the circumstances of learners.

Mongolia: education, mobility and family separation

Mongolia provides an important case for examining the benefits and limitations of education systems serving mobile populations. The country's low population density and extensive pastoral traditions have long created challenges for conventional school provision. Boarding

[129] UNESCO Global Education Monitoring Report (2021). *Providing Education for Nomadic People Requires a Flexible Approach*. World Education Blog, 15 February 2021, updated 28 January 2022. https://world-education-blog.org/2021/02/15/providing-education-for-nomadic-people-requires-a-flexible-approach/

schools have played a major role in providing access to formal education for children from herding households. By allowing children to stay near schools during the academic year, boarding arrangements can reduce the need for families to abandon pastoral livelihoods. However, they also separate children from their households for extended periods.

The UNESCO *Global Education Monitoring Report 2026* examines Mongolia's changing educational patterns and the interaction between pastoral livelihoods, economic development and migration. It finds that boarding schools continue to serve rural families, with children from herding households representing more than three quarters of applicants for boarding places. The report also documents persistent concerns about accommodation quality, children's wellbeing and unequal educational outcomes.[130]

Educational arrangements can affect family organisation. Some households move closer to schools, while others divide responsibilities between members who remain with livestock and those who accompany children. Access to education can therefore become a reason for migration rather than merely a service required after movement. The 2026 UNESCO assessment also shows how gender and livelihood expectations influence schooling. In some pastoral households, boys may be expected to participate in livestock activities, creating pressures that affect attendance and educational progression.

These findings caution against presenting boarding schools as an uncomplicated solution to educational mobility. They can improve access but may impose social and economic costs. For TEOS 2100, the lesson is that educational continuity must be considered alongside family relationships, livelihoods and children's wellbeing.

Education during displacement and environmental disruption

Environmental disasters can interrupt education through several mechanisms. Schools may be damaged or used as emergency accommodation. Transport routes may become inaccessible. Teachers and families may be displaced, while education authorities face difficulties identifying where learners have relocated. Displaced children may arrive in schools that already operate near their capacity. Differences in language, curriculum and administrative requirements can create additional barriers. These difficulties are not confined to climate-related displacement. They occur in contexts involving armed conflict, disasters and other forms of forced migration.

The UNHCR *Education Report 2026* estimates that 5.8 million refugee children were out of school in 2025. Reported gross enrolment rates were approximately 65 per cent in primary education, 32 per cent in secondary education and 11 per cent in tertiary education. The report highlights persistent problems concerning access, educational progression and financing.[131]

[130] UNESCO (2026). *Global Education Monitoring Report 2026: Access and Equity*. Country Case Study: Mongolia. Paris: UNESCO. https://www.unesco.org/gem-report/en/2026-gem-report-country-case-studies/mongolia

[131] UNHCR (2026). *UNHCR Education Report 2026: Pathways to the Future – Education, Opportunity and Self-Reliance*. Geneva: United Nations High Commissioner for Refugees. https://www.unhcr.org/media/unhcr-education-report-2026-pathways-future-education-opportunity-and-self-reliance

These figures concern refugee education and should not be interpreted as statistics for people moving because of environmental change. They nevertheless illustrate the difficulties of maintaining education where displacement disrupts established institutions. The implications for TEOS 2100 concern both emergency preparedness and longer-term planning. Education systems may need the capacity to absorb unexpected arrivals, provide temporary learning spaces and support learners who have missed substantial periods of instruction. Where movement becomes recurrent, temporary emergency arrangements alone may prove insufficient. More durable mechanisms for transferring records, recognising previous learning and coordinating school places could become necessary.

Continuity of learning across institutions

A learner who changes schools should not necessarily have to repeat previous instruction or lose recognition for work already completed. However, continuity can be difficult where education systems use different curricula, academic calendars, languages or assessment practices. Records may be incomplete, incompatible or unavailable. These problems become more consequential when learners move repeatedly. The student proposal underlying this report envisaged digital identifiers and records that could follow children between schools.

The underlying objective remains relevant, but a QR code or digital account would not by itself solve the institutional problem. A technical identifier can help retrieve information. It cannot establish whether a receiving institution recognises previous learning or how differences between curricula should be addressed. For TEOS 2100, educational continuity would require agreements concerning information, assessment and responsibility. Possible elements include transferable records of completed learning, common descriptions of learning outcomes and procedures for assessing learners when documentation is missing.

Such arrangements would need to accommodate different education systems without requiring complete curricular uniformity. They would also have to recognise that children develop at different rates and may require additional support after disruptions. The objective would not be to replace professional educational judgement with automated classification. It would be to provide teachers and institutions with sufficient information to support appropriate continuation of learning.

Digital learning and its limitations

Digital technologies can support education across changing locations. Online learning platforms, downloadable materials and electronic records may allow learners to continue activities when conventional school attendance is interrupted. However, their effectiveness depends on connectivity, electricity, access to devices and the availability of teachers or other educational support. Digital learning is therefore not inherently accessible to mobile or displaced populations.

UNICEF's *Learning Passport*, developed with support from Microsoft, provides an example of digital infrastructure designed to support education in different national and crisis contexts. The platform can be adapted to local curricula and delivered through online, low-bandwidth and offline arrangements. According to UNICEF's 2025 annual report, published in May

2026, the platform supported education continuity in several displacement-affected settings, including Bangladesh, Lebanon, Sudan and Syria.[132]

The report also documents an evaluation in Mexico showing improvements in learning outcomes among participating students. These results are relevant but should not be understood as proof that a digital platform can replace school systems or provide the same benefits in every setting. Education involves social interaction, safeguarding, assessment and institutional responsibility. Digital resources can complement these functions, but their use must be adapted to learners' circumstances. For TEOS 2100, the most plausible role of digital learning is to support continuity between institutions and periods of physical attendance.

Learner records, identity and privacy

The portability of learning records raises questions about personal identity and data protection. Children may need to demonstrate previous attendance, completed assessments or eligibility for a particular level of education. At the same time, educational records can contain sensitive information. They may include details about family circumstances, disability, health-related support needs or the reasons for displacement. Inappropriate disclosure could expose children and families to discrimination or other risks.

UNICEF's Learning Passport privacy framework addresses the collection, processing and protection of personal information within its digital services. However, the existence of a privacy policy does not eliminate the need for effective national legislation and institutional safeguards.[133]

For TEOS 2100, a portable educational record should therefore be distinguished from a system for tracking an individual's movements. The purpose would be to recognise learning and maintain access to education. Possible design principles include limiting the information exchanged, ensuring that records can be corrected, providing access without continuous connectivity and establishing clear responsibility for data protection.

Children who lack digital identification or whose records have been lost should retain access to education through alternative procedures. Educational rights must not depend exclusively on possession of a particular technical identifier.

Recognition of qualifications and prior learning

Mobility also creates difficulties for older learners and adults. Students may move between education systems that use different admission requirements or qualification frameworks. Workers may possess vocational skills that are not formally recognised in their new place of residence. Displaced people may have completed education but lack the documents required to demonstrate their qualifications. Recognition arrangements can reduce these barriers.

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[132] UNICEF (2026). *The Learning Passport: 2025 Annual Report*. Published May 2026. https://www.unicef.org/learningpassport/reports/2025-annual-report

[133] UNICEF (2025). *Learning Passport and Passport to Earning: Privacy Notice*. Updated April 2025. https://www.learningpassport.org/privacy-notice

UNESCO's *Global Convention on the Recognition of Qualifications concerning Higher Education*, adopted in 2019, entered into force on 5 March 2023.[134] The Convention establishes principles for fair, transparent and non-discriminatory recognition procedures among participating states. It also addresses situations in which refugees and displaced persons cannot provide complete documentary evidence of their qualifications.[135]

The Convention does not require automatic recognition of every qualification. Its significance lies in establishing procedural principles and cooperation mechanisms across national higher education systems. UNESCO's *Qualifications Passport* provides a complementary approach. It supports structured assessment of qualifications where standard documentation is incomplete or unavailable. The resulting assessment can help institutions consider applications for further education or employment, although it is not itself a degree and does not guarantee admission or professional recognition.[136]

For TEOS 2100, these existing arrangements demonstrate that recognition of learning can extend beyond the institution or territory in which it originally occurred. The same principle may be relevant to vocational education, non-formal learning and skills acquired through work. Developing broader recognition systems would require agreed standards, quality assurance and mechanisms for resolving disputed assessments.

Education for mobile livelihoods

Education in more mobile societies would need to respond to changing economic and environmental conditions. However, this does not imply that all learners should receive a separate curriculum designed specifically for migration. Foundational literacy, mathematics, scientific understanding and social learning would remain important. Additional educational needs could arise from changing livelihoods, environmental risks and the use of resources across several locations.

The experience of pastoral communities demonstrates the significance of practical and ecological knowledge. Krätli's research highlights the gap that can emerge when formal schooling fails to recognise knowledge that learners acquire through their communities and livelihoods. Education systems can also prepare learners for economic activities that differ from those previously available in their places of origin. This may include training related to infrastructure maintenance, agriculture, resource management, digital services and other occupations.

For TEOS 2100, education would need to combine continuity of foundational learning with opportunities for adaptation and vocational development. The aim should not be to train people for mobility as an unavoidable future. It should be to expand their ability to make informed decisions about remaining, moving or pursuing livelihoods across several locations.

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[134] UNESCO (2026). *Global Convention on Higher Education: What You Need to Know*. Updated 21 August 2026. https://www.unesco.org/en/higher-education/global-convention/about

[135] UNESCO (2019). *Global Convention on the Recognition of Qualifications concerning Higher Education*. Adopted 25 November 2019; entered into force 5 March 2023. https://www.unesco.org/en/legal-affairs/global-convention-recognition-qualifications-concerning-higher-education

[136] UNESCO (2024). *UNESCO Qualifications Passport: Inclusive Pathways to Education and Employment*. https://www.unesco.org/en/emergencies/qualifications-passport

Cultural continuity and social integration

Education contributes to cultural identity and social participation as well as economic activity. For mobile communities, frequent movement can affect access to language instruction, cultural practices and relationships with established institutions. Children may encounter different languages and social expectations when they enter receiving schools. At the same time, host communities may experience demographic changes that require educational institutions to respond to a more diverse student population.

Inclusive education can provide opportunities for interaction and reduce social separation. However, integration should not be equated with the abandonment of the languages and cultural traditions of incoming populations. Article 29 of the Convention on the Rights of the Child recognises respect for children's cultural identity and for the cultures of others as an objective of education. For TEOS 2100, this suggests that educational arrangements supporting mobile populations must consider both continuity of identity and participation in receiving communities.

Appropriate language support, recognition of prior learning and inclusive school practices may help reduce barriers. Educational institutions may also contribute to conflict prevention by creating shared spaces in which children from different backgrounds learn together. These outcomes cannot be assumed to follow automatically from school enrolment. They depend on teaching quality, institutional practices and the resources available to schools.

Governance and financing of education across locations

Education systems are financed and administered through arrangements that frequently depend on geographical responsibility. Schools may receive funding according to enrolment numbers, local population statistics or allocations from regional and national governments.

When populations move, the demand for education can change faster than funding arrangements. Receiving schools may require additional teachers, classrooms and learning materials. Schools in areas losing population may struggle to maintain staffing and infrastructure. Where children move repeatedly, authorities may need to determine which institution is responsible for educational records, assessment and continued support.

These issues connect education directly to the governance questions examined in Chapter 5.1. A possible response is to develop coordination arrangements between educational jurisdictions. Funding might take account of actual enrolment and the additional support needs associated with displacement or interrupted learning. Regional or national education authorities could establish procedures for transferring learner records and recognising completed instruction.

Cross-border mobility would require further agreements between states. Such arrangements would need to respect national responsibility for education while reducing the disadvantages associated with changing residence. They would also require financing. Educational portability cannot be achieved solely through digital systems if receiving schools lack teachers, facilities or appropriate learning materials.

Institutional pathways for education in a post-settlement future

The existing evidence provides several approaches relevant to the possible educational needs of more mobile societies. Mobile classrooms and seasonal programmes demonstrate how learning can be brought closer to communities whose livelihoods involve movement.

Boarding schools can provide access to formal education but may create difficulties associated with family separation and unequal living conditions. Digital platforms can help maintain learning during disruption, although they depend on infrastructure and educational support. Recognition frameworks can reduce barriers when learners move between institutions or countries. Administrative coordination may allow education records and public responsibilities to remain continuous across changes in residence.

For TEOS 2100, these approaches can inform a conceptual framework based on five institutional principles.

Continuity of educational rights means that changes in residence should not automatically interrupt access to education.

Flexibility of learning arrangements means that instruction can take place through different locations and formats without abandoning educational quality.

Recognition of prior learning means that knowledge and qualifications remain assessable when learners move.

Protection of personal information means that educational continuity does not depend on intrusive monitoring or the uncontrolled exchange of sensitive records.

Shared institutional responsibility means that schools and public authorities coordinate enrolment, assessment and financing across jurisdictions.

These principles are proposed as an analytical framework for TEOS 2100. They do not constitute an existing international education system or a tested model for the year 2100.

Implications for TEOS 2100

The possible emergence of more mobile societies does not eliminate the role of schools, teachers or established educational institutions. Instead, it raises questions about the relationship between learning and permanent residence.

Existing education systems already demonstrate different ways of accommodating movement. Mobile preschool programmes in Central Asia show that learning can be delivered in locations where conventional attendance is difficult. Mongolia's experience illustrates both the value and the limitations of boarding arrangements for pastoral households.

UNICEF's Learning Passport demonstrates the potential of digital infrastructure to support continuity during crises. UNESCO's recognition frameworks show that formal learning achievements can be assessed across national boundaries. The persistence of educational exclusion among displaced children demonstrates that these mechanisms remain insufficiently available or effective in many contexts.

For TEOS 2100, the challenge is therefore institutional rather than simply technological. A post-settlement education system would need to maintain access, quality and recognition when learners move between locations. It would also need to support those who remain in established communities, including settlements facing environmental and economic pressure.

Education should not require people to become permanently settled in order to obtain their rights. Nor should mobility be imposed as a condition of educational participation. The objective would be a system capable of providing continuity and meaningful learning opportunities across different forms of residence. Such a system could contribute to the wider institutional framework of a Post-Settlement Civilisation by allowing individuals to maintain their educational development despite changes in location.

The following section examines how economic systems, employment and social protection might adapt to related changes in residence and mobility.

5.3 Economic Systems

Economic activity is organised through relationships between people, resources, infrastructure and institutions. Many of these relationships depend on specific locations, but economic participation has never required all individuals to remain permanently in one place. Trade, seasonal employment, labour migration and cross-border investment already connect households and businesses across considerable distances.

Environmental change may alter these relationships by affecting the availability of resources, the productivity of particular locations and the distribution of population. As examined in Chapter 4, declining settlement viability in some regions could contribute to population movements towards areas offering more reliable access to water, employment and essential services. These movements would have economic consequences for both the regions people leave and those in which they seek residence.

For TEOS 2100, the question is how economic systems might continue to support livelihoods, investment and public services if residence and economic activity become less closely tied to a single location. A *Post-Settlement Civilisation* does not necessarily require an economy without fixed assets or permanent workplaces. Agriculture, manufacturing, energy production and essential infrastructure will continue to require physical locations.

The relevant possibility is that households and workers may become more mobile while production systems, institutions and property remain distributed across established and changing geographical locations.

Environmental change and the economic viability of settlement

Settlement viability depends partly on the availability of economic opportunities. Households require income or other means of obtaining food, housing and essential services. Businesses depend on labour, infrastructure, customers and access to resources. Environmental change can weaken these conditions. Water scarcity may reduce agricultural productivity or increase the cost of irrigation. Flooding can damage production facilities and

transport infrastructure. Extreme heat may reduce labour productivity and increase the costs of maintaining safe working conditions.

These effects can spread through economic relationships. Reduced agricultural output may affect food processing and local trade. Disruptions to electricity generation can constrain manufacturing and essential services. Where such pressures persist, businesses and households may reconsider the viability of existing activities. Some may invest in adaptation, modify production methods or diversify their sources of income. Others may relocate particular operations or seek economic opportunities elsewhere.

These responses depend on financial resources, institutional conditions and the availability of alternative livelihoods. The economic consequences of environmental change are therefore not determined solely by the severity of physical hazards. They also depend on the capacity of households, businesses and governments to respond. For TEOS 2100, a settlement may lose economic viability before it becomes physically uninhabitable. This creates an important connection between environmental change and potential population redistribution.

Labour mobility as an existing economic system

Labour mobility already forms a substantial part of the global economy. The International Labour Organization estimated that 167.7 million international migrants participated in the labour forces of their destination countries in 2022, representing approximately 4.7 per cent of the global labour force. These figures include migrant workers in many occupations and sectors. They do not measure climate-related migration or imply that all such workers are highly mobile throughout their working lives.[137]

Their significance for TEOS 2100 lies in demonstrating the existing scale of economic activity organised across national borders. Migrant workers contribute to agriculture, construction, manufacturing, healthcare, domestic services and other sectors. Their economic participation may connect several locations through employment, family relationships and financial transfers. Seasonal workers can move according to agricultural or tourism cycles. Other workers may remain abroad for extended periods while maintaining economic commitments in their communities of origin.

These arrangements demonstrate that economic activity can be distributed across geographical locations without requiring permanent relocation of entire households. However, the opportunity to participate in labour migration is unevenly distributed. Legal admission, recruitment arrangements, occupational qualifications and the cost of movement can restrict access. Migration may also involve insecure employment, exploitation or limited access to social protection. Mobility is therefore not inherently associated with economic freedom. Its contribution to livelihood security depends on the conditions under which people can move and work.

[137] International Labour Organization (ILO) (2024). *ILO Global Estimates on International Migrant Workers: International Migrants in the Labour Force*. Fourth edition. Geneva: ILO. https://www.ilo.org/publications/ilo-global-estimates-international-migrant-workers-international

Labour migration as climate adaptation

The International Organization for Migration's 2024 information sheet *Labour Migration and Climate Change* identifies regular labour migration as a possible adaptation strategy. Employment outside an environmentally exposed area can provide income, diversify household livelihoods and support investments in communities of origin. Migration can also facilitate the transfer of skills and knowledge. The IOM emphasises that these benefits depend on rights-based migration arrangements, decent working conditions and access to regular pathways for workers with different qualifications.[138]

For TEOS 2100, this distinction matters because environmental deterioration does not necessarily require all economic activity to leave an affected region. A household may continue agricultural production while some members earn income elsewhere. Remittances can help finance adaptation measures, education or the purchase of equipment. In other circumstances, environmental change may lead households to abandon previous livelihoods and establish economic activities at new locations.

These responses can occur within the same community. A future characterised by more frequent environmental disruption could therefore involve a combination of continued local production, seasonal employment, circular migration and permanent relocation. Such developments would not automatically constitute a new economic system. They could, however, increase the importance of institutions capable of supporting employment and income security across changing locations.

Remittances and geographically distributed household income

Remittances provide an existing mechanism through which income earned in one location supports households and economic activities elsewhere. They may be used for daily consumption, healthcare, education, housing, debt repayment or investment in businesses and productive assets. For families affected by environmental or economic pressures, remittances can diversify income and reduce dependence on local livelihoods.

The World Bank estimated that officially recorded remittances to low- and middle-income countries would reach approximately USD 685 billion in 2024[139]. This estimate highlighted the scale of private financial flows associated with international migration. Such transfers are not equivalent to public development finance. Their use is determined primarily by the individuals and households sending and receiving them. Nevertheless, they can influence local economic conditions and help households respond to financial shocks.

In October 2026, Huckstep and Clemens published an updated analysis of global bilateral remittance flows. Using a model based on migration stocks and economic differences between countries, they estimated how remittances were distributed across international

[138] International Organization for Migration (IOM) (2024). *Labour Migration and Climate Change*. Information Sheet, January 2024. Geneva: IOM. https://www.iom.int/sites/g/files/tmzbdl486/files/documents/2024-05/information-sheet-labour-migration-and-climate-change.pdf

[139] Ratha, D., Plaza, S., & Kim, E. J. (2024). In 2024, Remittance Flows to Low- and Middle-Income Countries Are Expected to Reach $685 Billion, Larger than FDI and ODA Combined. World Bank, 18 December 2024. https://blogs.worldbank.org/en/peoplemove/in-2024--remittance-flows-to-low--and-middle-income-countries-ar

corridors in 2024. Their results suggest that remittances are an important source of external finance for many countries and that substantial flows are concentrated in a limited number of migration corridors.[140]

The study found that 59 countries received remittances equivalent to more than five per cent of gross national income in 2024. However, the bilateral figures are modelled estimates rather than direct observations of every transfer. The authors explicitly caution that limitations in migration and financial data affect the reliability of individual corridor estimates. For TEOS 2100, the study is relevant because it demonstrates both the economic potential and the vulnerability of geographically distributed income.

Dependence and vulnerability in remittance economies

Remittances may improve household resilience, but they also create dependencies. A household receiving income from a family member abroad becomes partly exposed to employment conditions, immigration policies and economic developments in the destination country. Where substantial numbers of households depend on the same destination labour market, the resulting exposure may affect a wider region.

Huckstep and Clemens (2026) found that many remittance-receiving countries depend heavily on a small number of sending countries. Their model estimates that more than a quarter of countries received over half their remittances from a single source country in 2024. This concentration creates risks when economic or political conditions change in that country. The International Monetary Fund's 2026 assessment of low-income economies also identifies tighter immigration policies and changes in remittance taxation as potential risks to financial inflows.[141]

For TEOS 2100, increasing labour mobility could therefore create new forms of economic interdependence without necessarily reducing vulnerability. A household may become less dependent on local agriculture while becoming more dependent on an external labour market. The diversification of livelihood locations may improve resilience where income sources are genuinely independent.

However, dependence on a single employer, destination country or migration corridor can leave households vulnerable to disruptions beyond their control. The institutional challenge is therefore not simply to promote mobility. It is to support diversified and secure economic opportunities while reducing unnecessary restrictions on the movement of people and their financial resources.

The economic effects on receiving regions

Population movement can affect labour markets and economic activity in receiving regions. Additional workers may increase the supply of labour, support business expansion and

[140] Huckstep, S., & Clemens, M. (2026). *The Geography of Remittances: An Updated Global Bilateral Remittances Matrix*. CGD Note, 12 October 2026. Washington, DC: Center for Global Development. https://www.cgdev.org/publication/geography-remittances-updated-global-bilateral-remittances-matrix

[141] International Monetary Fund (IMF) (2026). *Macroeconomic Developments and Prospects in Low-Income Countries—2026*. IMF Policy Paper, 31 March 2026. Washington, DC: IMF. https://doi.org/10.5089/9798229043229.007

contribute to local demand for goods and services. They may also create competition in particular occupations or locations where employment opportunities are limited.

The effects on wages and employment are not uniform. They depend on the skills of incoming workers, the structure of the local economy, labour-market regulations and the extent to which businesses respond through investment and increased production. It would therefore be inaccurate to assume that an increase in migrant workers necessarily causes wages to fall.

Similarly, population growth can increase housing demand without producing a uniform increase in housing costs. The outcome depends on housing supply, planning regulations, infrastructure and the availability of land. Where housing construction and public services cannot keep pace with demand, affordability may deteriorate. Lower-income households, including both established residents and newcomers, may face increased pressure. The economic consequences of mobility therefore depend substantially on institutional conditions.

Effective housing policy, labour-market integration and infrastructure investment may allow receiving regions to benefit from population growth. Inadequate planning can contribute to unemployment, insecure housing and social tensions. These relationships connect the economic implications of TEOS 2100 to the resource and governance issues examined in earlier chapters.

Employment, informality and precarious work

A possible increase in population movement could affect the balance between formal and informal economic activity. Informal employment already exists in many countries and sectors. Workers may be employed without adequate contracts, social insurance or effective labour-law protection. Such arrangements are not restricted to migrants. However, people who lack secure residence status, recognised qualifications or access to established employment networks may face additional barriers to formal work.

Temporary migration can also create conditions in which workers depend heavily on intermediaries or individual employers. Where legal employment pathways are limited, people may accept insecure work because they have few alternatives. The ILO's research on social protection identifies temporary workers, workers with irregular hours, self-employed people and digital platform workers among groups that may experience gaps in social insurance coverage. Migrant workers can face additional legal and administrative barriers.[142]

For TEOS 2100, more mobile economic participation could increase the relevance of these problems. If workers move repeatedly between occupations or jurisdictions, systems that rely on uninterrupted employment with one employer may provide inadequate protection.

[142] International Labour Organization (ILO) (2024). *World Social Protection Report 2024–26: Universal Social Protection for Climate Action and a Just Transition*. Chapter 3: Extending Social Protection to Workers in All Types of Employment. Geneva: ILO. https://webapps.ilo.org/static/english/reports/flagship/world_social_protection_report_2024-26/Chapter%2003.html

The objective of institutional adaptation would be to enable mobility without making precarious employment its normal condition.

Portable social protection

Economic mobility can create difficulties for systems of pensions, unemployment protection, healthcare and occupational insurance. Social insurance arrangements often depend on contributions linked to employment and national legislation. When workers move between countries, they may encounter different eligibility conditions and administrative procedures.

Periods of employment may not automatically count towards benefits elsewhere. Some entitlements may be lost or become difficult to claim after a change of residence. These barriers can be serious for workers with fragmented employment histories. The ILO's *World Social Protection Report 2024-26* estimates that 52.4 per cent of the global population is covered by at least one social protection benefit. Coverage varies substantially between countries and income groups. The report identifies persistent protection gaps for people in irregular employment and emphasises the challenges faced by migrant workers.[143]

The ILO's 2024 strategy for extending social protection to migrants, refugees and their families identifies equality of treatment, inclusive national systems and international cooperation as important principles. It also supports agreements through which acquired social security entitlements can be recognised across borders.[144]

Existing coordination systems provide practical examples. As discussed in Chapter 5.1, the European Union coordinates aspects of national social security legislation for people moving between participating states.[145] These arrangements demonstrate that certain entitlements can be maintained or recognised across jurisdictions without creating a single supranational insurance system.

For TEOS 2100, comparable principles could inform economic arrangements supporting more mobile populations. However, portability would require agreements concerning contributions, financing, eligibility and administrative responsibility. It would also need to address workers whose employment is informal or whose incomes are insufficient to support contributory insurance. Portable benefits therefore represent an institutional challenge, not simply a question of digital recordkeeping.

Property, land values and the redistribution of wealth

Land and housing represent important forms of wealth in many societies. Property can provide shelter, income, collateral for borrowing and assets that can be transferred between

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[143] International Labour Organization (ILO) (2024). *World Social Protection Report 2024–26: Universal Social Protection for Climate Action and a Just Transition*. Executive Summary. Geneva: ILO. https://webapps.ilo.org/static/english/reports/flagship/world_social_protection_report_2024-26/Executive%20Summary.html

[144] International Labour Organization (ILO) (2024). *ILO Strategy on Extending Social Protection to Migrant Workers, Refugees and Their Families*. Geneva: ILO. https://www.ilo.org/publications/ilo-strategy-extending-social-protection-migrant-workers-refugees-and-their

[145] **European Parliament & Council of the European Union (2004).** Regulation (EC) No 883/2004 on the Coordination of Social Security Systems, as amended. https://eur-lex.europa.eu/eli/reg/2004/883/oj

generations. Environmental change may affect these functions. Land exposed to repeated flooding, water scarcity or declining agricultural productivity may lose some of its economic value. Buildings may remain physically intact while becoming more expensive to maintain or insure. Agricultural land may become less profitable where water availability or market access deteriorates.

These effects depend on local circumstances. Some properties may retain substantial value because adaptation measures reduce risk. Others may become difficult to use even when formal ownership remains legally secure. Population redistribution could produce additional differences between regions. Where demand for housing increases, land and property prices may rise if supply does not expand correspondingly. Property owners may benefit from rising values, while renters and households seeking to purchase housing face higher costs. Conversely, property owners in areas experiencing population decline may face reduced demand and falling asset values.

For TEOS 2100, this suggests a possible redistribution of wealth between locations and socioeconomic groups. Households that own property in receiving regions may benefit financially, while households whose main assets are located in environmentally deteriorating areas may experience losses.

These outcomes are not inevitable. Public investment, land-use regulation and housing policy can influence property values and access to housing. Nevertheless, the possibility of uneven changes in land values deserves consideration because it connects environmental change to economic inequality.

Ownership, use and the economic value of access

Chapter 4.4 examined historical and contemporary arrangements through which access to land can be separated from individual ownership. The Amazigh Agdal system and the Allmende of Southern Germany and Switzerland demonstrate that collective institutions can regulate resource use through established rights and obligations.

These examples also have an economic dimension. Access to grazing land, forests and other communal resources can support livelihoods without requiring each household to acquire exclusive ownership of those resources. The economic value lies partly in secure access rather than transferable property. For TEOS 2100, this distinction becomes relevant where people maintain livelihoods across several locations.

Ownership may remain appropriate for fixed productive assets, permanent housing and long-term investment. However, some economic activities may rely on recurring or temporary access to land, workplaces or infrastructure. The institutional question is how such access can be made reliable while protecting existing rights and supporting investment.

Flexible use rights should not be confused with unrestricted access. Economic activity requires predictable conditions. Farmers, pastoralists, employers and service providers need to know which resources they may use and under what rules. Shared or temporary arrangements therefore require institutions capable of defining rights, establishing responsibilities and resolving disputes.

Economic inequality and unequal mobility

The ability to move for economic reasons is not equally available to all households. Migration can involve expenses for transport, recruitment, documentation and accommodation. Individuals with recognised qualifications, financial resources and established social networks may have more opportunities to relocate. Those with fewer resources may face greater barriers.

This can create differences in the ability to respond to environmental pressures. A household with access to employment opportunities in another region may diversify its income. Another household facing similar environmental conditions may be unable to finance relocation or obtain the necessary legal permission.

Even where movement occurs, the economic results may differ. Skilled workers may enter formal employment, while others may face precarious work or uncertain income. Some households may receive substantial remittances. Others may experience prolonged separation without reliable financial support.

Huckstep and Clemens (2026) show that access to economically attractive migration destinations is highly unequal across countries of origin. Their analysis indicates that people from low-income countries are substantially less represented in high-income destination countries than migrants from middle-income countries. The resulting inequalities also influence access to remittance income.

For TEOS 2100, this suggests that economic mobility could reinforce existing inequalities unless institutions improve access to opportunities and protection. A future society characterised by greater movement would not necessarily be more economically inclusive. Its distributive consequences would depend on the rules governing labour markets, residence, social protection and access to productive resources.

Public finance under changing residence patterns

Population movement also affects the financing of public services. Governments require revenue to maintain infrastructure, education, healthcare and social protection. Tax systems are organised through combinations of residence, income sources, employment and economic activity. These rules already address many forms of cross-border employment and mobility. However, an increase in multi-local livelihoods could create additional administrative and fiscal challenges.

A worker may earn income in one jurisdiction, maintain a household in another and use public services in several locations. A municipality may provide housing-related infrastructure and services to people whose income taxes are paid elsewhere. Regions losing population may experience declining revenues while retaining responsibility for expensive infrastructure. Receiving regions may need to expand services before their tax base adjusts to increased demand.

These challenges are not unique to post-settlement scenarios. They already arise in commuting regions, metropolitan areas and countries with substantial cross-border labour mobility. For TEOS 2100, their potential significance lies in the possibility that such arrangements become more widespread.

One response could involve improved coordination between fiscal jurisdictions. Governments might adjust intergovernmental transfers according to changing service demand. Agreements could clarify responsibility for particular benefits and infrastructure costs. Administrative systems could support the recognition of employment and income across jurisdictions.

Such arrangements would need to protect against double taxation where treaties apply, tax avoidance and the exclusion of people whose residence is difficult to establish. The objective would be to maintain sustainable public finance despite changing patterns of economic activity and residence.

Investment and the transition between settlements

A potential contraction of viable settlement space could create difficult questions concerning long-term investment. Infrastructure projects, agricultural improvements and housing developments often depend on expectations about future population and resource availability. Where environmental conditions become less reliable, investment decisions may involve greater uncertainty. Businesses may hesitate to invest in locations where water supplies or transport connections are at risk. Public authorities may face choices between maintaining existing infrastructure and expanding capacity in receiving regions.

These decisions have distributional consequences. Reducing investment in an environmentally exposed settlement may accelerate economic decline, even where adaptation remains technically possible. Conversely, continuing to invest in highly exposed locations may limit resources available for other needs.

For TEOS 2100, the relationship between adaptation and relocation therefore has an economic dimension. Decisions about settlement viability can affect asset values, employment opportunities and public finances. They should not be interpreted as purely technical responses to environmental hazards.

Transparent assessment, public participation and consideration of distributional effects may help institutions manage such decisions.

Economic institutions for more mobile societies

Existing economic systems already contain arrangements that could support greater mobility. Labour migration programmes provide pathways into employment across national borders. Remittance systems transfer household income between locations. Social security agreements coordinate some entitlements across jurisdictions. Rental arrangements and other tenure systems provide access to housing without requiring ownership. Public finance mechanisms distribute resources between different levels of government.

These arrangements demonstrate that a mobile economy need not begin from an entirely new institutional foundation. However, their limitations are significant. Access to labour migration may be unequal. Remittances can create external dependencies. Social protection remains incomplete. Housing and employment rights may be difficult to enforce. For TEOS 2100, the relevant question is how such arrangements could be coordinated more effectively

under changing environmental and settlement conditions. Five economic principles emerge from the preceding analysis.

Livelihood diversification concerns maintaining access to economic opportunities across different activities and locations.

Secure labour mobility concerns legal pathways, decent working conditions and protection against exploitation.

Continuity of social protection concerns preserving access to income security, healthcare and other benefits despite changes in residence or employment.

Equitable access to productive resources concerns reconciling ownership, use rights and the interests of established and incoming populations.

Fiscal coordination concerns financing infrastructure and public services where population and economic activity extend across several jurisdictions.

These principles are proposed as an analytical framework for TEOS 2100. They are not an established model of a post-settlement economy. Their feasibility would depend on economic conditions, institutional capacity and political decisions.

Implications for TEOS 2100

The economic consequences of environmental change may extend beyond the locations where physical risks first emerge. Water insecurity, infrastructure damage and declining productivity can affect livelihoods and the viability of settlements. Population redistribution can shift demand for housing, labour and essential services towards other regions. These movements may create economic opportunities while placing additional pressure on infrastructure and public institutions.

Remittances and labour migration already demonstrate how households can distribute economic activity across locations. Their significance could increase where environmental pressures encourage diversification of livelihoods. However, mobility also creates vulnerabilities. Workers may face insecure employment and incomplete social protection. Households may become dependent on distant labour markets. Property owners in environmentally exposed locations may experience declining asset values, while rising prices in receiving regions could benefit established owners and disadvantage people seeking accommodation.

These developments could intensify existing economic inequalities. A Post-Settlement Civilisation would therefore require more than the technical capacity to work remotely or transfer money across borders. It would require institutions capable of maintaining economic rights, access to services and public finance under changing patterns of residence.

Existing arrangements offer possible starting points. The institutional challenge is to connect them in ways that support mobility without undermining employment security, established rights or the economic viability of communities. For TEOS 2100, the objective is not to establish an economy in which all people are continuously mobile. It is to examine whether economic participation can remain secure and inclusive when permanent residence in one

location becomes less reliable for some populations. The following section considers how these economic and institutional changes may affect social relationships and cohesion.

5.4 Social Cohesion

Social cohesion concerns the relationships through which individuals and groups participate in society, develop trust and manage differences in interests and identities. It includes relationships between members of a community, between different social groups and between populations and the institutions exercising authority over them. These relationships are influenced by economic conditions, political participation, social networks, shared institutions and perceptions of fairness.

Permanent residence can support social cohesion by allowing relationships to develop over time. Schools, workplaces, neighbourhoods and local organisations provide opportunities for cooperation and participation. However, permanent settlement is not a necessary condition for maintaining strong social relationships. Mobile communities may sustain collective identities, reciprocal obligations and social institutions across considerable distances.

For TEOS 2100, the possible emergence of more mobile societies raises questions about how social relationships can remain stable when residence, employment and access to resources become less closely connected to one location. The potential contraction of viable settlement space could create additional pressures. Population movements towards receiving regions may alter established relationships and increase competition over housing, employment and essential services.

These developments could create tensions, but their consequences are not predetermined. The central question is which social and institutional conditions could support cohesion among populations with different relationships to place.

Social cohesion and the experience of displacement

Displacement can disrupt established social relationships. People leaving their homes may lose regular contact with neighbours, colleagues and community organisations. They may also experience the loss of familiar cultural environments, institutions and places associated with personal or collective identity. Such disruptions can affect wellbeing and reduce access to informal support. Social networks often provide practical assistance through childcare, employment contacts, shared resources and mutual support during emergencies. When these networks are weakened, households may become more dependent on formal institutions or assistance from unfamiliar communities.

However, displacement does not always eliminate social relationships. Families may move together, maintain communication with people in their places of origin or establish new networks at their destinations. Existing migrant communities may provide accommodation, information and opportunities for employment. The effects of movement therefore depend on whether social relationships can be maintained, adapted or rebuilt.

The World Bank's 2023 report *Social Cohesion and Forced Displacement: A Synthesis of New Research* reviewed findings from 26 background studies across different regions. The synthesis found that displacement can exacerbate existing inequalities and create potential

for conflict, particularly where economic opportunities are limited and public services are strained. It also found that inclusive policies and development investments can help reduce inequalities and improve relationships between displaced and host populations.[146] These findings concern forced displacement and cannot be transferred without qualification to every form of climate-related migration. They nevertheless demonstrate that population movement does not have a uniform effect on social cohesion.

Relations between established and incoming populations

When people move into an established settlement, they enter a community with existing social relationships, economic interests and institutional arrangements. Established residents may possess property, employment networks and recognised access to public services. Newcomers may have fewer local connections or face restrictions related to legal status and administrative registration. These differences can influence opportunities for participation and economic security.

Competition for housing and employment may create perceptions that the interests of one group are being advanced at the expense of another. Disagreements may also arise over public assistance, access to water or the use of communal land. However, the presence of newcomers does not necessarily undermine existing communities.

An analysis published in *World Development* in 2024 synthesised new research on forced displacement and social cohesion. The authors found that the arrival of displaced populations does not inevitably reduce cohesion in receiving communities. The economic and social conditions of receiving regions influence relations between established residents and newcomers, while integrative public policies can improve these relationships.[147]

This finding is relevant to TEOS 2100. It suggests that social tensions should not be attributed to migration alone. Housing shortages, unemployment, unequal access to public services and perceived institutional unfairness may be more directly relevant to the development of conflict. The distinction matters because these conditions can be influenced through policy and public investment.

Resource competition and perceptions of fairness

Chapter 4.3 examined the existing competition over water, land, food and energy in the Hindu Kush Himalayan region. These resources support livelihoods and essential services, but their availability and distribution vary across locations and social groups. Environmental change may increase uncertainty concerning their future availability. Population redistribution could add pressure where additional demand becomes concentrated in receiving regions.

[146] World Bank (2023). *Social Cohesion and Forced Displacement: A Synthesis of New Research*. Washington, DC: World Bank. Available through UNHCR: https://data.unhcr.org/en/documents/details/99136

[147] World Bank research contributors (2024). Forced Displacement, Social Cohesion, and the State: Evidence from Eight New Studies. *World Development*, 173, 106416. https://doi.org/10.1016/j.worlddev.2023.106416

Such pressures may affect social cohesion when access to resources is perceived as unfair. Established residents may fear that newcomers will receive priority for housing or public assistance. Incoming populations may experience exclusion from services or economic opportunities. Disagreements can become more intense where allocation procedures are unclear or where affected groups have limited opportunities to influence decisions.

The IPCC's Sixth Assessment Report identifies relationships between climatic hazards, migration and social tensions. However, the evidence linking climate-related migration directly to organised violence remains limited and context-dependent. The IPCC finds that climate change can influence conflict risk through economic and social mechanisms, including livelihood insecurity and unequal resource access. Political and institutional conditions strongly influence the outcome.[148]

For TEOS 2100, the relevant hypothesis is therefore not that migration will inevitably produce conflict. It is that competition over resources and public services may intensify if the demand placed on receiving regions increases while their capacity to accommodate additional populations remains constrained. Social cohesion would depend partly on how institutions manage these competing claims.

Political exclusion and the limits of territorial membership

Social cohesion also depends on relationships between people and political institutions. Individuals who contribute to local economic and social life may nevertheless have limited influence over decisions affecting them. This can occur where voting rights, eligibility for public services or participation in local institutions depend on citizenship or permanent residence.

For people maintaining livelihoods across several locations, these arrangements may create uncertainty about political membership. A person may remain a citizen of one state while living and working elsewhere. A household may use services in several municipalities while possessing formal residence in only one. These circumstances already exist, but their significance could increase if multi-local living becomes more widespread.

Chapter 5.1 examined the possibility of protecting some political and social rights across changes in residence. For social cohesion, the issue extends beyond administrative continuity. People need opportunities to express their interests and influence decisions that affect their lives. Where newcomers lack meaningful participation, policies may be perceived as imposed rather than negotiated.

Conversely, established residents may become distrustful if decisions concerning housing, land or infrastructure are made without their involvement. For TEOS 2100, inclusive governance therefore provides a connection between political rights and social cohesion.

[148] Intergovernmental Panel on Climate Change (IPCC) (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Working Group II Contribution to the Sixth Assessment Report. Chapter 7: Health, Wellbeing and the Changing Structure of Communities, particularly Sections 7.2.6–7.2.7. https://www.ipcc.ch/report/ar6/wg2/chapter/chapter-7/

Borders and legal insecurity

Cross-border movement introduces additional difficulties. People may face restrictions concerning entry, residence, employment and access to public services. Where environmental deterioration contributes to movement, the available legal protections depend on national and international law. The 1951 Refugee Convention does not recognise environmental harm alone as an independent ground for refugee status.

However, people affected by environmental change may qualify for refugee protection where the applicable legal requirements are met, including circumstances involving persecution. Other human rights obligations may also constrain removal in situations involving serious risks to life or other protected rights.

The United States case *Cruz Galicia v. Garland*, decided in 2024, illustrates the limitations of existing refugee law. The United States Court of Appeals for the First Circuit rejected a claim based on membership in a proposed social group identified as climate refugees, finding that the group lacked the social distinction required under the applicable asylum framework. The decision did not establish that every person affected by climate change is categorically excluded from asylum.[149] Lopez (2026) discusses the case in an examination of the protection gap affecting people displaced by environmental change.[150]

For TEOS 2100, legal insecurity may influence social cohesion when people remain unable to establish recognised residence or participate fully in receiving communities. However, migration restrictions and legal status must be distinguished from social relationships themselves. The existence of legal barriers does not establish that newcomers and established populations will necessarily develop hostile relations.

Resettlement, power and cultural continuity

Organised relocation may reduce exposure to environmental hazards while creating social and cultural difficulties. People may be moved away from locations associated with family histories, livelihoods and collective identity. The choice of resettlement location can influence access to employment, education, land and community networks. Relocation may also alter established relationships between communities and authorities responsible for land and resource management.

A 2026 article by Abreek-Zubiedat and Katz examines the historical and political dimensions of climate-related resettlement in the Global South. The authors argue that some resettlement practices reproduce patterns of unequal power associated with colonial governance, land appropriation and the imposition of external planning models.[151] Their argument draws attention to the authority exercised by institutions that determine where and

[149] United States Court of Appeals for the First Circuit (2024). *Cruz Galicia v. Garland*, No. 23-1285, decided 13 June 2024. Available through Refworld: https://www.refworld.org/jurisprudence/caselaw/usaca1/2024/148501

[150] Lopez, A. (2026). The Failure to Recognize Climate Refugees: Domestic Law vs. International Reality. *The Undergraduate Law Review at UC San Diego*, 4(1). https://escholarship.org/uc/ucsdulr/4/1

[151] Abreek-Zubiedat, F., & Katz, I. (2026). Climate Change Resettlement and Inhabitation: Spatialising Cultures of Colonial Pasts and Alternative Futures in the Global South. *Environment and Planning E: Nature and Space*, 9(1), 3–14. https://doi.org/10.1177/25148486251411656

how displaced people should live. However, their analysis should not be interpreted as evidence that every internationally supported resettlement programme reproduces colonial relationships.

The relevance to TEOS 2100 lies in the need to examine how decisions are made and whose interests they serve. Relocation can become socially disruptive where affected communities have little influence over planning or where the resulting settlement fails to support existing livelihoods and cultural relationships. Conversely, participation in decisions about location, housing and resource access may help communities maintain greater control over their futures. The distinction between voluntary and involuntary movement is therefore central.

Social cohesion within existing mobile societies

The assumption that social cohesion depends on permanent settlement is challenged by existing mobile societies. Pastoral communities may maintain relationships through seasonal movement, shared livelihoods and recognised access to resources. Kinship networks, customary institutions and reciprocal obligations can connect people across several locations. Cultural continuity may therefore be maintained through patterns of movement rather than through continuous occupation of a single settlement.

Prout Quicke and Green (2018) examine the politics of mobility among Indigenous Australian communities. Their research shows how state housing policies that assume stable household composition and fixed residence can conflict with established patterns of mobility. The authors identify how inappropriate regulation of movement can reinforce social and economic marginalisation.[152]

This does not mean that all Indigenous communities are mobile or that their experiences can be reduced to one model. It demonstrates that some institutions have been designed around assumptions of permanent residence that do not reflect the practices of the communities they serve. For TEOS 2100, this suggests that social cohesion may depend partly on whether public institutions recognise different ways of organising community life. Mobility should not automatically be treated as social disorganisation.

Mongolia and the transformation of pastoral communities

Mongolia provides an example of how environmental, economic and institutional change can affect established mobile societies. Nomadic pastoralism has long been associated with the use of extensive grassland resources. Seasonal movement allows households to respond to changes in forage availability and environmental conditions. Social relationships, shared knowledge and cooperation between households support these activities.

Drees and colleagues (2022) examined possible futures for pastoralism in Mongolia through a transdisciplinary scenario-development process. Their research involved pastoralists, public authorities, conservation actors and other stakeholders. The scenarios considered the effects of policy, economic development, resource competition and environmental change on

[152] Prout Quicke, S., & Green, C. (2018). “Mobile (Nomadic) Cultures” and the Politics of Mobility: Insights from Indigenous Australia. *Transactions of the Institute of British Geographers*, 43(4), 646–660. https://doi.org/10.1111/tran.12243

pastoral livelihoods. The study identifies risks associated with weakened social relationships, declining influence of pastoral communities in public decision-making and growing competition over grazing resources.[153]

It also demonstrates that future outcomes depend on policy choices and the capacity of institutions to support pastoral livelihoods. For TEOS 2100, the Mongolian example is relevant because it shows that mobility can support social identity and collective organisation. At the same time, mobile societies can experience social fragmentation when economic pressures and institutional arrangements weaken their established relationships. Mobility alone does not determine whether cohesion is maintained.

Community membership and the inclusion of newcomers

The customary systems discussed in Chapter 4.4 provide another perspective on social cohesion. The Amazigh Agdal system and the historical Allmende of Southern Germany and Switzerland demonstrate how communities can organise access to resources through recognised membership and collective rules. Such arrangements can create predictable obligations and strengthen cooperation among eligible users.

However, membership rules can also restrict access. A community that manages land collectively may protect established rights while excluding newcomers. This creates a potential difficulty for receiving regions under conditions of sustained population redistribution. If more people seek access to resources already governed by established communities, institutions will need to reconcile legitimate existing claims with the needs of incoming populations.

The challenge is not to eliminate community membership. It is to create procedures through which access, participation and responsibilities can be negotiated. This may involve temporary use rights, agreements between communities and arrangements that recognise different levels of participation. Such mechanisms would require transparent rules and protection against discrimination.

For TEOS 2100, a central social question is whether membership can become sufficiently flexible to accommodate mobility without undermining the relationships through which communities maintain cohesion.

Maintaining connections across several locations

Social relationships do not necessarily end when people move. Families may maintain connections through communication, travel and financial support. Religious, cultural and professional associations can operate across geographical boundaries. People may participate in communities associated with both their places of origin and their current residence.

[153] Drees, L., Liehr, S., Batbuyan, B., Marg, O., & Mehring, M. (2022). In Search of a Nomadic Pastoralism for the 21st Century: A Transdisciplinary Development of Future Scenarios to Foster a Social-Ecological Transformation in Mongolia. *Innovation: The European Journal of Social Science Research*, 35(3), 481–505. https://doi.org/10.1080/13511610.2022.2100744

These relationships can provide continuity during economic or environmental change. Chapter 5.3 examined remittances as one mechanism linking households across locations. Financial transfers may support relatives who remain in environmentally exposed regions. However, social connections involve more than income. They include care responsibilities, shared knowledge, cultural practices and forms of mutual support.

For TEOS 2100, the possibility of multi-local social relationships deserves consideration alongside multi-local economic activity. A person may retain strong connections to a place of origin while becoming involved in a new community. Such relationships do not require complete assimilation into one social environment.

However, maintaining connections across several places can also be demanding. Distance may weaken regular participation, care arrangements may become difficult and people may experience uncertainty about belonging. The potential benefits of multi-local social organisation therefore depend on the availability of communication, transport and institutions that recognise different forms of participation.

Institutions for preventing social conflict

Research on displacement and social cohesion identifies several approaches that can reduce tensions between established and incoming populations.

The first concerns access to essential services. Where water supply, healthcare, education and housing are already inadequate, population growth may create additional pressures. Investment that benefits both established residents and newcomers can reduce competition and perceptions of unequal treatment.

The second concerns participation. People affected by decisions about resource allocation and local development should have opportunities to express concerns and contribute to planning.

The third concerns mechanisms for resolving disputes. Community mediation, accessible complaints procedures and formal legal remedies can provide ways of addressing disagreements before they escalate.

UNHCR's guidance on community-based protection recommends working through existing community structures where possible, supporting inclusive local leadership and strengthening relationships between displaced and host communities. It also emphasises the importance of community-led initiatives that respond to shared priorities.[154]

The World Bank's research on forced displacement similarly identifies inclusive policies and development investment as potential means of improving relations between groups. These approaches do not guarantee social cohesion. They require administrative capacity, adequate resources and institutions that are trusted by affected populations. Nevertheless, they demonstrate that conflict prevention can be incorporated into the ordinary functions of local governance.

[154] UNHCR (2025). *Community-Based Protection*. Emergency Handbook, updated guidance. https://emergency.unhcr.org/protection/protection-mechanisms/community-based-protection-cbp

Trust, information and public communication

Social cohesion depends partly on whether people trust the institutions responsible for decisions affecting their lives. Uncertainty about resource allocation, eligibility for public assistance or changes in local population can create conditions in which misinformation spreads.

Rumours about preferential treatment may contribute to distrust even where actual allocation rules are different. Similarly, inaccurate information concerning newcomers may reinforce social exclusion. Public institutions can reduce these risks through transparent communication and accessible information. However, communication alone cannot resolve material shortages or unequal access. It must be connected to credible procedures for decision-making and accountability.

UNHCR's guidance on community-based approaches to information integrity recognises the role of displaced and host communities in identifying misinformation and interpreting its local consequences. The guidance emphasises the value of working with community-led organisations and trusted local networks.[155]

For TEOS 2100, such approaches may become relevant where populations change rapidly or where multiple communities depend on the same resources and services. Trust cannot be created solely through technical systems or public messaging. It depends on whether institutions act consistently, allow participation and provide effective remedies when decisions are challenged.

Social cohesion under a contraction of viable settlement space

The hypothesis of a contraction of viable settlement space creates a possible long-term challenge for social cohesion. Where environmental pressures reduce the viability of some settlements, people may seek residence in regions offering more favourable conditions. These receiving regions may themselves face resource constraints. Population growth could increase demand for housing, employment and public services.

At the same time, established communities may experience changes in their social environments and expectations concerning local resources. If these pressures persist, institutions may need to accommodate more diverse and variable patterns of residence. Some people may settle permanently, while others maintain temporary or recurring relationships with several locations.

The consequences for social cohesion would depend on how access, membership and political participation are organised. Arrangements that exclude newcomers from essential services or decision-making may contribute to marginalisation and distrust. Conversely, institutions that recognise different patterns of residence while protecting established rights could support cooperation.

[155] UNHCR (2025). *Community-Based Approaches*. Information Integrity Toolkit, updated 28 February 2025. https://www.unhcr.org/handbooks/informationintegrity/practical-tools/response-strategies/community-based-approaches

The process would not necessarily lead to a uniform weakening of local communities. Some settlements might develop new forms of social organisation that incorporate mobile and established populations. Others could experience prolonged tensions where resources are limited or governance is ineffective. For TEOS 2100, these outcomes remain possibilities rather than predictions.

Social cohesion in a post-settlement future

A possible Post-Settlement Civilisation would require institutions capable of supporting social relationships across different patterns of residence.[156] The historical association between community membership and permanent settlement may become less sufficient where individuals maintain livelihoods, family relationships and civic participation across several locations.

However, this does not imply that geographical communities will lose their significance. Neighbourhoods, villages and cities may continue to provide social relationships and public institutions. The potential change concerns whether these relationships must be exclusive. Individuals may increasingly participate in several communities while maintaining different degrees of attachment and responsibility.

Such arrangements could create opportunities for new forms of cooperation. They could also raise questions concerning representation, resource allocation and accountability. For TEOS 2100, social cohesion should therefore be understood as the capacity to maintain trust, participation and mutual support despite differences in residence and mobility. The relevant institutional principles are:

Recognition of diverse community relationships, including membership that extends across several locations.

Equitable access to essential services, reducing avoidable competition between established and incoming populations.

Meaningful participation, allowing affected groups to influence decisions concerning resources and public institutions.

Accessible conflict resolution, providing legitimate procedures for addressing competing claims.

Protection of cultural continuity, enabling people to maintain established identities and social relationships while participating in new communities.

These principles are proposed as an analytical framework for TEOS 2100. They do not describe a universally applicable social model or establish that greater mobility will necessarily improve cohesion.

[156] European Commission, Service for Foreign Policy Instruments (2026). *Final Evaluation of the Two Projects to Strengthen Social Cohesion between Displaced Populations and Host Communities in Burkina Faso and Niger*. https://fpi.ec.europa.eu/projects/projects-action/final-evaluation-two-projects-strengthen-social-cohesion-between-displaced-populations-and-host_en

Implications for TEOS 2100

The possible development of more mobile societies raises questions about the conditions under which social cohesion can be maintained. Existing research demonstrates that population movement does not inevitably weaken relationships between established and incoming populations. The effects depend on economic opportunities, access to services, public institutions and the capacity of communities to participate in decisions affecting their lives.

At the same time, environmental change and population redistribution may intensify existing pressures. Competition over water, housing, land and employment could create new disagreements or reinforce established inequalities. These tensions may become more difficult to resolve if receiving regions experience environmental constraints of their own.

Existing mobile societies provide a different perspective. Indigenous Australian mobility practices and Mongolian pastoralism demonstrate that movement can form part of established cultural and social institutions. However, they also show that mobility can become difficult to sustain when public policies, economic pressures or environmental changes weaken the relationships on which communities depend.

For TEOS 2100, the distinction between mobility and social fragmentation is essential. A Post-Settlement Civilisation should not be understood as a society in which people lose their local or cultural attachments. It describes the possibility that social participation and collective responsibility could remain meaningful across different locations. The central question is whether institutions can support these relationships while managing competing claims on resources and public services.

Social cohesion would therefore remain an institutional and political task rather than a natural consequence of either permanent settlement or mobility. The following section considers the legal, physical and organisational conditions required to make movement possible and secure.

5.5 Mobility

Mobility is a central element of human adaptation to changing environmental, economic and social conditions. People move to obtain employment, maintain family relationships, access services and respond to threats affecting their livelihoods. These movements take different forms. Some involve permanent relocation, while others are temporary, seasonal or recurrent. Individuals and households may also maintain economic and social relationships across several locations without abandoning an established place of residence.

Climate change may alter the conditions under which these movements occur. Environmental hazards can force people to leave their homes, while gradual changes in water availability, agricultural productivity and economic opportunities may influence decisions about where to live and work. For TEOS 2100, the potential contraction of viable settlement space raises questions about the ability of people to move safely and maintain their rights across different locations.

However, greater environmental pressure does not necessarily result in greater mobility. People may lack the financial means, legal permission or physical infrastructure required to

relocate. Others may remain because of cultural attachments, social responsibilities or the absence of acceptable alternatives. The central challenge is therefore not simply to accommodate increasing movement. It is to establish conditions under which people can choose whether to remain, move temporarily or relocate more permanently, without losing access to essential rights and services.

Mobility, immobility and the ability to choose

The distinction between voluntary mobility, constrained mobility and forced displacement is fundamental to the analysis of climate-related population change. People may move as part of a planned livelihood strategy, including seasonal employment or the diversification of household income. They may also leave because environmental hazards make continued residence unsafe.

In other circumstances, households may remain in exposed locations despite increasing risks. This may reflect a positive decision to maintain residence, but it may also result from insufficient resources or legal barriers. Boas and colleagues (2022) examine these relationships through the concept of *climate mobilities*. Their analysis challenges approaches that treat environmental change as a direct cause of migration and instead emphasises the interaction of mobility, immobility, social inequality and political institutions.[157]

The authors argue that mobility must be considered in relation to the systems that enable or restrict movement. Borders, labour markets, property arrangements and public policies influence who can move, under which conditions and with what consequences.

For TEOS 2100, this perspective is essential. A future in which environmental pressures reduce settlement viability may create stronger reasons for people to leave some locations. Yet the ability to move may remain unequally distributed. A society characterised by greater mobility cannot therefore be evaluated solely by the number of people changing residence. The conditions under which movement occurs matter equally.

The right to move and the right to remain

Human rights law provides a starting point for examining mobility. Article 12 of the International Covenant on Civil and Political Rights recognises freedom of movement and choice of residence for persons lawfully within a state's territory, subject to specified permissible restrictions. It also recognises the right to leave any country and protects individuals against arbitrary deprivation of the right to enter their own country.

These provisions do not establish a general right to enter or settle in any other state. International movement therefore remains shaped by national immigration legislation and the international obligations of states. Different rules apply to citizens, residents, refugees and other groups. The right to remain also requires consideration.

People should not be treated as having an obligation to relocate merely because their communities face environmental risks. Where adaptation can support safe and viable

[157] Boas, I., Wiegel, H., Farbotko, C., Warner, J., & Sheller, M. (2022). Climate Mobilities: Migration, Im/Mobilities and Mobility Regimes in a Changing Climate. *Journal of Ethnic and Migration Studies*, 48(14), 3365–3379. https://doi.org/10.1080/1369183X.2022.2066264

residence, individuals and communities may have strong reasons to preserve established social, cultural and economic relationships. The United Nations Guiding Principles on Internal Displacement, presented in 1998, recognise protection against arbitrary displacement.

They also identify the rights of internally displaced people to freedom of movement, protection during displacement and voluntary return or resettlement under appropriate conditions.[158] The Guiding Principles are not a treaty and do not create an unrestricted right to cross international borders. They nevertheless provide a framework for assessing how governments should protect people affected by displacement within their territories.

For TEOS 2100, the institutional objective should be the preservation of meaningful choices. Mobility should be possible where people need or wish to move. Remaining should also remain an option wherever conditions allow safe and sustainable residence.

Legal pathways for cross-border mobility

Cross-border mobility depends on arrangements that determine who may enter another country, how long they may remain and which activities they may undertake. These arrangements include immigration visas, residence permits, employment programmes, family reunification and humanitarian admission. They differ substantially between countries.

Climate change does not currently provide a general, independent entitlement to international admission or permanent residence. The 1951 Refugee Convention protects people who satisfy its definition of a refugee. Environmental deterioration alone is not an independent ground for refugee status under that Convention. However, environmental harm can interact with persecution and other circumstances relevant to refugee protection.

Human rights obligations may also restrict the removal of a person to a place where the individual would face sufficiently serious risks. The United Nations Human Rights Committee addressed this possibility in *Teitiota v. New Zealand*. In its decision concerning the removal of a citizen of Kiribati, the Committee found that the circumstances of the individual case did not establish a violation of the right to life. However, it also recognised that climate-related conditions could, in sufficiently serious circumstances, engage obligations not to return a person to a country where their rights would be at risk.[159]

The decision did not create a general category of climate refugees. It demonstrated that climate-related harm may become relevant to the application of existing human rights protections. For TEOS 2100, the distinction between legal admission pathways and protection against return is important. A person may need an opportunity to relocate before conditions become life-threatening. Protection systems that respond only after severe harm has occurred may therefore be insufficient for anticipatory adaptation.

[158] United Nations Commission on Human Rights (1998). *Guiding Principles on Internal Displacement*. UN Document E/CN.4/1998/53/Add.2, particularly Principles 6, 14, 15 and 28. https://digitallibrary.un.org/record/251969

[159] United Nations Human Rights Committee (2020). *Ioane Teitiota v. New Zealand*. Communication No. 2728/2016, CCPR/C/127/D/2728/2016, Views adopted 24 October 2019 and distributed 7 January 2020. https://digitallibrary.un.org/record/3869621

The Australia-Tuvalu Falepili Union

The Australia-Tuvalu Falepili Union provides a contemporary example of bilateral cooperation linking climate adaptation, sovereignty and human mobility. The treaty was signed on 9 November 2023 and entered into force on 28 August 2024. It recognises the continuing statehood and sovereignty of Tuvalu notwithstanding the effects of climate-related sea-level rise. It also establishes a framework for cooperation on climate adaptation and security.

Article 3 commits Australia to creating a special mobility pathway through which citizens of Tuvalu can live, work and study in Australia. The provision includes access to education, healthcare and specified income and family support arrangements on arrival.[160] The treaty is significant because it places mobility within a broader relationship between two sovereign states. It recognises Tuvalu's interest in maintaining its territory, population and national identity while providing an additional option for citizens who wish to live elsewhere.

The agreement therefore does not assume that the entire population must relocate. Nor does it treat movement as equivalent to the disappearance of Tuvalu's statehood. For TEOS 2100, this distinction connects directly to Chapter 5.1. The possibility of maintaining citizenship and international legal personality while people reside elsewhere is relevant to future discussions of population redistribution and territorial change.

Implementation of the Falepili Mobility Pathway

The Falepili Mobility Pathway is implemented through Australia's Pacific Engagement Visa, subclass 192, Treaty stream for Tuvalu. The visa provides permanent residence in Australia. Eligible holders can live, work and study in Australia while maintaining the ability to travel between Australia and Tuvalu. The programme does not require a person to obtain an Australian job offer before applying. An electronic ballot is used to select eligible candidates who may then apply for the visa. The initial annual allocation was up to 280 places.

The second programme-year ballot opened on 1 May 2026 and closed on 1 June 2026. For the 2026-2027 programme year, Australia again allocated up to 280 visa places, including eligible family members. The number available in subsequent years is to be agreed by the two governments.[161]

The distinction between selection in the ballot and the granting of a visa is important. Selection does not automatically establish eligibility for permanent residence. Applicants must satisfy the relevant visa conditions. The programme also involves support services intended to assist with employment, access to public services and settlement.

For TEOS 2100, the pathway provides evidence that states can create regular migration arrangements which do not require migrants to sever their relationships with their country of

[160] Australia and Tuvalu (2023). *Australia-Tuvalu Falepili Union Treaty*, signed 9 November 2023, entered into force 28 August 2024, particularly Articles 2-4. https://www.dfat.gov.au/geo/tuvalu/australia-tuvalu-falepili-union-treaty/treaty-text-falepili-union

[161] Australian Government, Department of Home Affairs (2026). *Pacific Engagement Visa (Subclass 192), Treaty Stream (Tuvalu)*. Programme information for 2026–2027. https://immi.homeaffairs.gov.au/visas/getting-a-visa/visa-listing/pacific-engagement/subclass-192-treaty-stream

origin. Its scale and eligibility conditions also demonstrate the limits of such arrangements. The programme is designed for a particular bilateral relationship and a defined population. It should not be presented as an existing general model for climate-related migration worldwide.

Mobility, sovereignty and unequal negotiating power

The Falepili Union also illustrates the political complexities of bilateral mobility agreements. The treaty links human mobility and climate cooperation with security commitments. Under its security provisions, Tuvalu agrees to consult and reach mutual agreement with Australia concerning certain security and defence relationships with other states or entities.

These provisions have generated debate about the balance between sovereignty, security cooperation and the interests of the participating countries. Kemp Whimp (2026) examines the agreement in the context of Tuvalu's longer history of constitutional and foreign-policy development. The analysis challenges interpretations that present Tuvalu primarily as a passive recipient of Australian assistance. It emphasises the objectives pursued by Tuvalu in negotiating the relationship.

A separate study by Ullah (2026) examines the treaty as an example of the continuing limitations of international approaches to climate displacement. The author argues that the treaty provides a practical pathway while exposing the absence of a comprehensive international framework.[162]

These analyses demonstrate that mobility arrangements involve political choices. They may provide opportunities and protection while also creating new obligations between states.

For TEOS 2100, negotiated mobility cannot be treated as a purely humanitarian or administrative process. The distribution of authority, benefits and responsibilities between participating states must also be considered.

Mobility within the Hindu Kush Himalayan region

The Australia-Tuvalu agreement concerns a small island state facing risks associated with sea-level rise. The environmental and political circumstances of the Hindu Kush Himalayan region differ considerably. The region contains multiple states, substantial urban populations and extensive networks of agriculture, trade and employment. Environmental pressures may affect livelihoods through changing water availability, flooding, landslides, extreme heat and other processes.

Movement may occur within national borders, between neighbouring countries or through established labour-migration corridors extending beyond the region. Some populations may seek permanent relocation. Others may maintain seasonal or circular movements, including

[162] Kemp Whimp, J. (2026). An Unthinkable Question: Tuvalu and the Falepili Union. *Victoria University of Wellington Law Review*, 56(2), 193–224. https://doi.org/10.26686/vuwlr.v56i2.10760. See also Ullah, W. (2026). The Tuvalu Precedent: Necessary Paradox and the Limits of Climate Displacement Governance. *Climate Risk Management*, article 100853. https://doi.org/10.1016/j.crm.2026.100853

established pastoral and agricultural mobility. For TEOS 2100, these different forms of movement should not be treated as a single migration process.

Internal displacement, cross-border migration, transhumance and multi-local residence involve different legal and institutional arrangements. A bilateral model similar to the Falepili Union could be relevant to some circumstances, but it could not automatically address the full range of mobility associated with the Hindu Kush Himalayan region. The scale, diversity and political relationships of the region would require approaches adapted to particular migration corridors and institutional contexts.

Infrastructure as a condition of mobility

The physical ability to move depends on infrastructure. Roads, bridges, railways, airports and border crossings connect settlements to economic opportunities, public services and emergency assistance. Communication systems provide information about transport conditions, hazards and available support. Where these systems are inadequate, people may be unable to move safely even when they possess the necessary financial and legal resources. Mountain environments create additional difficulties. Steep terrain, landslides, flooding and unstable slopes can interrupt transport networks. Environmental change may affect the reliability of roads and other infrastructure already exposed to natural hazards.

The major Himalayan disasters of 2026 illustrate these risks. In August 2026, a rock-and-ice collapse associated with Langtang Lirung produced a destructive flood in Nepal. ICIMOD subsequently reported another serious mountain-collapse event in the Budhi Gandaki basin in October. Its assessment of 13 October 2026 identified limitations in warning systems designed primarily around rainfall and river monitoring. The events demonstrated that some mountain hazards can develop through processes not adequately captured by conventional monitoring arrangements.[163]

For TEOS 2100, the relevance is broader than the individual disasters. Infrastructure enabling mobility may itself be vulnerable to environmental change. A transport corridor intended to support evacuation or relocation can become inaccessible during the event that makes movement necessary. Mobility planning therefore requires attention to infrastructure resilience, alternative routes and the reliability of emergency communication.

Early warning, evacuation and planned movement

Not all mobility is a response to gradual environmental change. Sudden disasters may require rapid evacuation. The effectiveness of evacuation depends on the availability of warnings, transport, safe destinations and coordination between responsible institutions. Warnings alone may be insufficient where people lack transport or where evacuation routes are damaged.

People with disabilities, older residents, children and households without private vehicles may face additional difficulties. Remote communities may depend on a limited number of

[163] International Centre for Integrated Mountain Development (ICIMOD) (2026). *Second Major Himalayan Flood in Seven Weeks Raises Alarm over Compounding Mountain Hazards*. Press release, 13 October 2026. https://www.icimod.org/press-releases/second-major-himalayan-flood-in-seven-weeks-raises-new-questions-about-mountain-risk/

routes. Cross-border hazards can create further challenges when information is not shared promptly between authorities.

The Platform on Disaster Displacement identifies disaster risk reduction, preparedness and planned relocation as areas of international cooperation. Its 2024-2030 strategy promotes stronger implementation of existing legal protections and practical measures to reduce displacement risks.[164] The organisation also recognises that planned relocation may be necessary where people cannot remain safely in their existing settlements.

However, relocation should not be treated as a substitute for appropriate adaptation. Decisions should account for the preferences of affected communities, the availability of viable destinations and the long-term consequences for livelihoods and social relationships. For TEOS 2100, mobility planning therefore includes both emergency response and the management of longer-term environmental change.

Return, circular mobility and multi-local residence

Population movement should not always be interpreted as a permanent transfer from one settlement to another. People may leave temporarily after a disaster and return when conditions improve. Others may establish employment in a receiving region while maintaining family or property relationships elsewhere. Some households may move repeatedly according to seasonal opportunities or environmental conditions.

These arrangements already occur through labour migration and established pastoral mobility. For TEOS 2100, the possibility of circular or multi-local residence is relevant because environmental change may alter conditions unevenly across seasons and locations.

However, repeated movement is not necessarily a preferred or sustainable response. It may impose costs associated with transport, housing and the separation of households. Legal and administrative barriers can further complicate movement. A person may be able to enter a country but lack the right to work. Temporary residence may provide access to shelter without supporting long-term economic participation. A visa may permit repeated travel while limiting eligibility for public benefits.

These differences influence whether mobility contributes to adaptation or creates additional insecurity. The Falepili Mobility Pathway provides an example of a legal status that allows continuing movement between two countries. Its relevance lies in the combination of stable residence rights with the possibility of maintaining transnational relationships. For TEOS 2100, similar principles may become relevant where households retain legitimate interests in several locations.

Mobility and unequal access

The ability to move is distributed unequally. Households with financial resources, recognised qualifications and established social networks may have more opportunities to relocate. Others may face barriers related to transport costs, documentation, employment restrictions

[164] Platform on Disaster Displacement (2024). *Strategy 2024–2030*. Geneva: Platform on Disaster Displacement. https://disasterdisplacement.org/the-platform/our-response/

or inaccessible information. hese differences can become more consequential where environmental pressures affect livelihoods.

People with sufficient resources may move before conditions deteriorate substantially. Those without comparable resources may remain in increasingly exposed settlements. Some may rely on irregular migration routes that increase their vulnerability to exploitation and unsafe travel. The economic implications were examined in Chapter 5.3.

For mobility governance, the corresponding question concerns whether legal and physical access can be made available to people with different social and economic circumstances. The design of migration pathways matters. Selection systems based entirely on income, occupational qualifications or employer sponsorship may exclude people whose livelihoods have been most severely affected by environmental change.

Other arrangements may distribute opportunities more broadly but remain limited by the number of available places. The Falepili ballot illustrates one approach intended to reduce selection differences associated with employment or educational qualifications. However, its limited annual allocation means that the pathway cannot accommodate every eligible person who might wish to participate. For TEOS 2100, equitable mobility requires attention to both formal eligibility and the practical ability to use available arrangements.

Protection against exploitation and exclusion

Mobility can create vulnerabilities when people depend on intermediaries, employers or temporary accommodation providers. Migrants may encounter misleading recruitment practices, excessive fees or working conditions that are difficult to challenge. People without secure residence status may hesitate to seek legal assistance or report violations.

These risks are not unique to environmental migration. They occur in many contemporary labour-migration systems. However, people displaced by environmental deterioration may have limited financial reserves or reduced opportunities to return home. Such circumstances can increase dependence on available employers or service providers. For TEOS 2100, legal migration pathways would therefore need to be accompanied by labour protections, accessible information and effective remedies.

Protection should also extend to people whose movement does not involve employment. Children, older people and individuals requiring medical support may depend on arrangements concerning family unity, education and healthcare. The capacity to travel does not by itself establish the ability to live securely at the destination. This connects mobility governance with the institutional requirements developed in Chapters 5.1 to 5.4.

The role of regional cooperation

Movement within and beyond the Hindu Kush Himalayan region often involves several administrative and political jurisdictions. National governments regulate entry, residence and employment. Regional and local authorities provide infrastructure and essential services. Border authorities manage crossings and documentation. Humanitarian organisations may provide assistance during displacement.

Effective cooperation requires clarity about the responsibilities of these institutions. For cross-border movement, bilateral and regional agreements can establish admission arrangements, administrative procedures and mechanisms for sharing information. For disaster response, neighbouring states may coordinate warnings, border operations and temporary access to safe locations.

The Platform on Disaster Displacement promotes cooperation through existing regional and international frameworks rather than relying exclusively on the development of new global legal instruments. Its approach recognises that different circumstances require different responses, including temporary protection, humanitarian admission and regular migration pathways.[165]

For TEOS 2100, this offers a pragmatic starting point. States may develop arrangements suited to particular regions and migration corridors while maintaining their territorial responsibilities. However, regional cooperation should not become a means of transferring responsibility without ensuring adequate protection. The effectiveness of agreements depends on their implementation and the rights available to affected people.

Mobility and the preservation of social relationships

Movement affects more than physical location. People maintain relationships with families, communities and institutions that may extend across several places. Relocation can interrupt these connections, particularly where movement is involuntary or occurs under insecure conditions. Chapter 5.4 examined the importance of social cohesion for mobile and receiving populations.

For mobility governance, the corresponding issue is how institutions can support social continuity. Family reunification, the ability to return, recognition of cultural relationships and access to communication can influence the consequences of movement. The Falepili Union explicitly recognises the importance of Tuvaluans' connections to their land and culture. Its mobility provisions were developed alongside commitments to climate adaptation intended to support continued residence in Tuvalu.

This combination illustrates that maintaining a country of origin and enabling movement need not be opposing objectives.

However, the experience cannot be transferred mechanically to other regions. Communities differ in their relationships with land, political institutions and cultural traditions. For TEOS 2100, mobility should be understood as one possible element of social adaptation rather than as a replacement for established communities.

Institutional pathways for mobility in a post-settlement future

Existing evidence demonstrates that mobility can be supported through different legal and administrative arrangements. Regular migration pathways provide opportunities for

[165] Platform on Disaster Displacement. *What We Do*. Information on cross-border disaster displacement, planned relocation and regular migration pathways. https://disasterdisplacement.org/what-we-do/

employment and residence across borders. Human rights obligations can protect individuals against return to circumstances involving sufficiently serious harm.

Disaster preparedness and evacuation planning can reduce risks during sudden environmental events. Transport infrastructure enables access to safer locations and economic opportunities. Arrangements permitting circular movement can help people maintain connections with several places. These mechanisms already exist, although their availability and effectiveness vary considerably. For TEOS 2100, five principles provide a basis for exploring more secure forms of mobility.

Freedom of choice concerns the ability to remain, move temporarily or relocate where meaningful alternatives exist.

Accessible legal pathways concern transparent and predictable procedures for residence, employment and protection.

Safe physical mobility concerns transport infrastructure, early warning systems and the availability of viable routes.

Continuity of rights and services concerns maintaining legal status, education, healthcare and social protection during movement.

Institutional coordination concerns cooperation between local authorities, states and international organisations.

These principles are proposed as an analytical framework for TEOS 2100. They do not constitute an existing universal mobility regime. Their implementation would depend on legal agreements, administrative capacity, infrastructure investment and political decisions.

Implications for TEOS 2100

The potential contraction of viable settlement space may increase the need for people to move between locations. However, mobility alone does not resolve the environmental and economic problems that contribute to population redistribution. People require viable destinations, legal protection and access to the resources necessary to establish or maintain livelihoods.

The Australia-Tuvalu Falepili Union demonstrates that states can create negotiated pathways which combine residence rights with the possibility of continuing relationships across borders. Its recognition of Tuvalu's continuing sovereignty also connects mobility to the changing understanding of territorial statehood examined in Chapter 5.1. At the same time, the agreement shows the limits of existing approaches. Its eligibility criteria, limited annual allocation and bilateral political obligations reflect the circumstances of the two participating states.

The Hindu Kush Himalayan region involves a different range of environmental pressures, population movements and institutional relationships. The development of mobility arrangements in this region would therefore require approaches suited to its geographical and political conditions. Physical infrastructure and disaster preparedness would be central

to their feasibility. The Himalayan events of 2026 demonstrate the vulnerability of transport routes and the limitations of some existing monitoring systems.

Mobility also remains subject to economic inequality. Those with sufficient resources and recognised legal status may be able to move safely, while others remain exposed or encounter insecure migration conditions. For TEOS 2100, the relevant challenge is therefore not to create a society in which permanent residence becomes undesirable.

It is to examine how movement could remain a secure and legitimate option when environmental conditions make continued residence more difficult. A Post-Settlement Civilisation would require institutions that accommodate different relationships between people and places without treating mobility as a substitute for rights, public services or social belonging. The following section considers how technology may support such arrangements and where technological solutions remain limited by institutional and social conditions.

5.6 Technology

Technological development influences how people work, communicate, obtain information and access essential services. Many activities that previously required physical presence can now be performed, coordinated or supported across geographical distances. These developments create new possibilities for people whose residence and economic activities extend across several locations.

Digital communication can help maintain social relationships during migration. Remote working arrangements can separate certain forms of employment from a fixed workplace. Electronic records can support continuity in education and healthcare when people move between institutions. Environmental monitoring and early warning systems may also improve the ability of communities to respond to changing conditions.

For TEOS 2100, the potential emergence of more mobile societies raises questions about how these technologies could contribute to secure livelihoods and access to public services. However, technological development does not eliminate the physical foundations of settlement. Food production, housing, water supply, energy infrastructure and many forms of employment remain dependent on material resources and specific locations.

Digital systems themselves require electricity, communication networks, equipment and institutions responsible for their operation. A *Post-Settlement Civilisation* should therefore not be understood as a technologically detached society in which geographical conditions cease to matter. The relevant possibility is that technology could make some relationships between residence, economic participation and public services more flexible, provided that the necessary infrastructure and rights remain available.

The digital divide as a limit to mobility

Digital technologies are already widely used, but access remains unequal. The International Telecommunication Union estimated that approximately six billion people used the Internet in 2025, representing about 74 per cent of the global population. Around 2.2 billion people

remained offline. The ITU also identified substantial differences in connectivity quality, affordability and digital skills between regions and income groups.[166]

These differences affect the ability to use digital services. A person may live in an area covered by a mobile network but lack the income required to purchase sufficient data. Other users may depend on unreliable electricity supplies or possess devices that cannot support particular applications. Digital literacy and accessibility present further barriers.

Such limitations are relevant to climate-related mobility because the populations most exposed to environmental disruption may also experience constrained access to communication infrastructure. In mountain regions, geographical conditions can increase the costs of network deployment and maintenance. Flooding, landslides and extreme weather may damage communication systems when they are most urgently needed.

For TEOS 2100, the digital divide therefore represents more than a difference in access to convenience or economic opportunity. It can influence whether people receive warnings, contact relatives, obtain public information or maintain access to services during displacement. Technological solutions intended to support mobile populations must account for these limitations.

Digital nomadism and the changing relationship between work and place

Digital nomadism provides a contemporary example of economic activity organised across changing locations. Digital nomads generally use communication technologies to perform work while travelling or residing outside a conventional permanent workplace. Their occupations may involve software development, consulting, design, digital services or other activities that can be carried out remotely.

Lacárcel (2025) examined the relationship between digital technologies, mobility and the lifestyles of digital nomads. The study used 25 interviews with digital nomads, platform representatives and academics to identify factors influencing working practices, destination choices and perceptions of sustainability. Its findings illustrate how digital platforms and communication tools can support geographically flexible employment.[167]

However, this form of mobility is not representative of all occupations or population groups. Remote work generally requires suitable professional activities, reliable connectivity and access to appropriate equipment. It may also depend on financial resources, legal permission to work and the availability of suitable accommodation.

Digital nomadism should therefore be distinguished from displacement caused by environmental deterioration. Individuals who choose to work remotely while travelling may possess options unavailable to people forced to leave their homes after disasters or economic losses. For TEOS 2100, the significance of digital nomadism lies in demonstrating that some forms of economic participation can be separated from continuous presence in

[166] International Telecommunication Union (ITU) (2025). *Measuring Digital Development: Facts and Figures 2025*. Geneva: ITU. https://www.itu.int/itu-d/reports/statistics/facts-figures-2025/
[167] Lacárcel, F. J. S. (2025). Digital Technologies, Sustainable Lifestyle, and Tourism: How Digital Nomads Navigate Global Mobility? *Sustainable Technology and Entrepreneurship*, 4(2), 100096. https://doi.org/10.1016/j.stae.2025.100096

one workplace. It does not establish that digital employment can replace location-dependent livelihoods on a large scale.

The limits of remote work

A substantial proportion of economic activity requires physical presence. Agriculture depends on land, water, labour and machinery. Manufacturing relies on production facilities and supply chains. Construction, transport and many care services require workers to operate in particular locations.

Digital technologies can support these activities through planning, coordination and monitoring. They cannot remove all their material requirements. Remote work also depends on economic relationships that extend beyond the individual worker. Employers, clients, payment systems, telecommunications providers and public authorities influence the conditions under which work can be performed.

Cross-border remote employment may create questions concerning taxation, labour protection, social insurance and legal residence. These questions were examined in Chapter 5.3. For TEOS 2100, remote work could expand the range of livelihood options available to some mobile households. However, its benefits would remain unevenly distributed unless education, infrastructure and institutional arrangements improve access. The distinction between the technical possibility of remote work and the economic ability to participate in it must therefore be maintained.

Telemedicine and healthcare across locations

Healthcare is another field in which digital technologies can reduce some barriers associated with distance. Telemedicine enables certain medical consultations, assessments and follow-up services to take place without requiring patients and clinicians to occupy the same physical location. Remote monitoring and electronic records can support continuity of care when individuals move between providers.

These applications may be valuable in remote mountain settlements and for populations whose livelihoods involve regular movement. However, telemedicine cannot replace all forms of physical healthcare. Emergency treatment, surgery, laboratory testing, vaccination and many diagnostic procedures require equipment, trained personnel and appropriate facilities.

Digital consultations also depend on reliable connectivity, suitable devices and the availability of health professionals. The World Health Organization's *Global Strategy on Digital Health 2020–2027*, published in its extended form in December 2025, emphasises that successful digital health initiatives require coordinated financial, organisational, human and technological resources.[168]

The strategy does not present digital health as a substitute for functioning healthcare systems. Instead, it provides a framework for integrating technologies into systems that remain responsible for delivering care. For TEOS 2100, this distinction is essential. The

[168] World Health Organization (WHO) (2025). *Global Strategy on Digital Health 2020–2027*. Geneva: WHO. Published 1 December 2025. https://www.who.int/publications/i/item/9789240116870

possibility of accessing a clinician remotely is valuable, but it does not guarantee access to treatment. Healthcare continuity requires both digital and physical infrastructure.

Healthcare access among existing mobile populations

Existing mobile communities demonstrate the limitations of healthcare systems organised around permanent residence and fixed facilities. Morgan and Sengedorj (2023) examine healthcare access among nomadic peoples, including pastoral communities and groups with traditions of mobility. Their analysis identifies geographical distance, institutional exclusion, discrimination and socioeconomic conditions as factors affecting healthcare access. It also discusses the risk that mobile populations become insufficiently visible within conventional healthcare planning and service provision.[169]

These difficulties cannot be resolved through telemedicine alone. A community may require mobile clinics, accessible transport or arrangements for obtaining medication during seasonal movement. Healthcare staff may need to understand the livelihood patterns and cultural practices of the populations they serve. Administrative procedures may also require adaptation where patients do not maintain permanent residence near a particular healthcare facility.

For TEOS 2100, the example demonstrates that technological development must be combined with changes in service organisation. Digital consultation systems can form part of such arrangements, but their contribution depends on the availability of appropriate care and the recognition of patients' rights.

Portable medical records and the European Health Data Space

The movement of patients between healthcare institutions creates difficulties where medical records are incomplete or unavailable. Information about diagnoses, medication, allergies and previous treatment can be important for continuity of care. Electronic records may allow this information to be accessed across locations.

However, technical compatibility is only one requirement. Institutions also need lawful procedures for exchanging sensitive data, identifying patients and determining which professionals may access records. The European Health Data Space provides a contemporary example of institutional development in this area. Regulation (EU) 2025/327 entered into force on 26 March 2025.

It establishes a framework for improved access to and exchange of electronic health data within the European Union. Its application is being introduced in stages. Under the scheduled implementation, cross-border exchange of patient summaries and electronic prescriptions is to become mandatory from March 2029, with additional categories of health information following in March 2031.[170]

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[169] Morgan, J., & Sengedorj, T. (2023). Nomadic Peoples and Access to Healthcare. In *Social Science Perspectives on Global Public Health*. Routledge. https://doi.org/10.4324/9781003128373-16

[170] European Parliament & Council of the European Union (2025). Regulation (EU) 2025/327 of 11 February 2025 on the European Health Data Space. *Official Journal of the European Union*, 5 March 2025. https://eur-lex.europa.eu/eli/reg/2025/327/oj

As of November 2026, these provisions have not yet been fully implemented. The regulation therefore represents a developing institutional framework rather than evidence that seamless cross-border healthcare records are already universally available. For TEOS 2100, it demonstrates that cooperation between jurisdictions can provide a legal basis for more portable health information.

It does not remove the need for national health services, patient identification or data protection. The continuity of medical information should also be distinguished from the portability of healthcare coverage. A patient may possess accessible records without being entitled to the same services or benefits in every jurisdiction.

Digital education and learning continuity

Education can also be supported through digital systems. Online platforms, downloadable materials and communication tools allow some learning activities to continue when learners are unable to attend a particular institution. Such arrangements may be relevant to children from mobile households, learners displaced by disasters and adults whose employment involves frequent movement.

Chapter 5.2 examined existing approaches to flexible learning and the recognition of educational achievements across institutions. Digital technologies can contribute by providing access to learning materials, supporting communication with teachers and maintaining records of completed activities. Elmi (2026) explores the potential use of artificial intelligence to support education for nomadic populations.

The author discusses adaptive learning platforms and virtual classrooms as possible means of responding to differences in location, educational experience and learning needs.[171] The paper provides a conceptual assessment of possible applications. It should not be interpreted as evidence that AI-supported education for nomadic communities has already been implemented successfully at scale.

For TEOS 2100, the relevance lies in identifying educational functions that might become less dependent on continuous attendance at one location. However, the recognition of learning remains an institutional responsibility. Digital systems can record activities and support assessment, but they cannot independently determine how qualifications should be recognised by schools, employers or public authorities.

Artificial intelligence and educational adaptation

Artificial intelligence may support the development and adaptation of learning materials. Possible applications include translation, feedback, assistance with reading and the adjustment of exercises to different levels of prior knowledge. These capabilities could be useful where learners move between education systems or encounter differences in language and curriculum.

However, AI-generated material can contain errors, misleading explanations and inappropriate cultural assumptions. The use of automated systems may also create risks

[171] Elmi, F. (2026). Reimagining Education: Potential Solutions for Nomads. In L. Belli & W. B. Gaspar (Eds.), *AI from the Global Majority*. Springer, Cham. https://doi.org/10.1007/978-3-032-07830-8_20

involving student data and unequal access. UNESCO's 2023 *Guidance for Generative AI in Education and Research*, updated in January 2026, calls for a human-centred approach to the development and use of these technologies. The guidance emphasises privacy, age-appropriate use, institutional oversight and the professional responsibilities of educators.[172]

For TEOS 2100, artificial intelligence should therefore be considered as a possible support for teachers and learners rather than as a replacement for educational institutions. A learner who moves repeatedly may benefit from adaptable materials. Nevertheless, teaching quality, safeguarding, social interaction and recognition of educational achievement remain dependent on human and institutional responsibilities.

Digital identity and access to public services

Mobile populations may encounter difficulties when access to public services depends on documents issued or stored in a particular jurisdiction. Identity records, proof of qualifications and evidence of social insurance contributions can be lost during displacement or become difficult to retrieve. Digital identity systems may help establish continuity.

However, their availability remains uneven. The World Bank's 2025 *Identification for Development Global Dataset* estimates that approximately 800 million people worldwide lack official identification. It also estimates that at least 2.8 billion people lack access to a government-recognised digital identity suitable for secure online transactions.[173]

These figures demonstrate the limitations of assuming that all individuals can rely on digital credentials. A digital identifier can also establish identity without resolving questions about legal status or service eligibility. For example, the ability to authenticate a person's identity does not create a right to enter another country, receive a pension or access a particular healthcare system. Such rights depend on legislation and administrative agreements.

For TEOS 2100, digital identity could support continuity across changing locations. However, it should not become an exclusive condition for obtaining essential services. Alternative procedures remain necessary for people who cannot access or use digital systems.

Environmental monitoring and Earth observation

The role of technology in TEOS 2100 extends beyond supporting people who move. It also concerns the monitoring of environmental conditions that influence settlement viability. Satellite observations, remote sensing, hydrological monitoring and geographic information systems can provide information about changes in glaciers, snow cover, vegetation, river systems and land stability.

These technologies are relevant to the Hindu Kush Himalayan region because many hazards develop in remote or difficult-to-access environments. Ground-based monitoring may be limited by terrain, infrastructure and political boundaries. Earth observation (EO) can

[172] Miao, F., & Holmes, W. (2023). *Guidance for Generative AI in Education and Research*. Paris: UNESCO. Updated 16 January 2026. https://www.unesco.org/en/articles/guidance-generative-ai-education-and-research

[173] World Bank (2025). *Identification for Development: 2025 Global Dataset*. Washington, DC: World Bank. https://id4d.worldbank.org/global-dataset

supplement local measurements and support the identification of areas requiring closer investigation.

However, observations do not automatically provide reliable predictions. Interpreting satellite data requires scientific expertise, appropriate models and information about local conditions. Different hazards also require different monitoring approaches. A system designed primarily to detect changes in rainfall or river levels may not identify the instability preceding a major rock-and-ice collapse.

For TEOS 2100, environmental monitoring can support adaptation and public planning. It may improve understanding of how settlement conditions are changing and help identify risks before they become disasters. Its effectiveness depends on the connection between scientific information and institutions capable of acting on it.

The 2026 Gyirong-Rasuwa disaster: technology and its limits

The disaster of 26 August 2026 in the Gyirong-Rasuwa border region provides an example of the opportunities and limitations of environmental monitoring. A catastrophic collapse involving rock and glacier ice in the Langtang region generated a destructive surge through the transboundary mountain corridor.

ICIMOD's preliminary assessment, published on 13 October 2026, combined satellite observations, seismic data, drone imagery and other evidence to reconstruct the event. The study identified ground deformation visible in Sentinel-1 radar observations during the weeks preceding the collapse.

However, these observations did not result in a timely warning capable of preventing the disaster. The assessment identified substantial gaps in monitoring and early warning, including the limited suitability of systems designed primarily for rainfall-driven flooding and conventional glacial lake outburst floods.[174]

The example demonstrates that the existence of observational data does not guarantee an operational warning. Scientific interpretation, communication and decisions about protective measures must occur before a hazard develops into a disaster. For TEOS 2100, this distinction is central.

Technology may improve the ability to identify environmental risks, but effective adaptation requires institutions capable of translating information into action. Cross-border information sharing is also relevant because hazards and their consequences may extend beyond national jurisdictions.

Technology for adaptation and settlement viability

The technologies examined in this chapter may influence both mobility and the capacity to remain in existing settlements. Environmental monitoring can inform decisions about infrastructure and land use. Communication networks can support emergency warnings and

[174] International Centre for Integrated Mountain Development (ICIMOD) (2026). *Understanding the Gyirong–Rasuwa Disaster of 26 August 2026: A Preliminary Synthesis*. Published 13 October 2026. https://doi.org/10.53055/ICIMOD.1150

coordination. Digital healthcare and education can improve access to some services in remote locations. Remote economic activities may create additional livelihood opportunities where local employment is limited.

These possibilities suggest that technology could contribute to maintaining settlement viability. However, the benefits will depend on the nature of the environmental pressure. Digital services cannot replace drinking water where local supplies become inadequate. Remote working opportunities cannot eliminate exposure to unstable slopes or repeated flooding. Improved forecasting may provide time for evacuation but cannot always prevent physical damage.

For TEOS 2100, technology should therefore be assessed in relation to specific functions. Some technologies may reduce exposure to hazards. Others may support adaptation within an existing settlement. Others may enable people to maintain services and relationships after relocation. These functions are related but should not be conflated. The deployment of technology may expand available choices without removing the environmental limits examined in earlier chapters.

Dependence on energy and communication infrastructure

Digital systems depend on infrastructure that can itself be disrupted. Communication networks require electricity, equipment maintenance and connections to wider systems. Data centres and digital services depend on physical facilities and supply chains. Remote areas may have limited redundancy when networks fail.

Disasters can damage electricity distribution and telecommunications at the same time. For people depending on digital systems to obtain warnings, access services or communicate with relatives, such failures can have immediate consequences. A mobile society organised around electronic records and online services could therefore become vulnerable to infrastructure disruptions.

This creates a need for resilient system design. Possible approaches include backup electricity supplies, alternative communication channels, offline access to essential information and procedures for obtaining services when digital systems are unavailable. However, these measures involve additional costs and require ongoing maintenance. For TEOS 2100, technological resilience must therefore be considered alongside the reliability of the underlying infrastructure.

Privacy, surveillance and the risks of digital exclusion

Digital systems can improve administrative continuity, but they can also increase the capacity of institutions to monitor individuals. Location data, identity records and information about service use may reveal sensitive aspects of a person's movements and relationships. For displaced populations, inappropriate disclosure could create risks involving discrimination, exploitation or political persecution.

Systems intended to support mobility should therefore avoid making continuous location monitoring a condition of accessing essential services. Data collection should remain proportionate to legitimate administrative purposes. Individuals also require effective

mechanisms for correcting inaccurate information and challenging decisions that affect their rights.

These issues become more significant where public services depend on automated assessments. An error in a digital record may affect access to education, healthcare or financial support. Automated systems may also reproduce discriminatory outcomes if their design or underlying data are inadequate.

The WHO's guidance on the ethics and governance of artificial intelligence for health identifies human rights, privacy, accountability and the need for regulatory oversight as central conditions for responsible deployment.[175] For TEOS 2100, the relevant principle is that technological systems should support legal rights rather than become independent authorities determining who is entitled to protection.

The governance of digital infrastructure

The development of digital services for mobile populations raises questions about ownership and institutional responsibility. Communication networks, digital identity systems and platforms for public services may be operated by governments, private companies or combinations of institutions. Their governance affects reliability, affordability and access.

A service may depend on commercial pricing or technical standards controlled by organisations outside the jurisdiction where users reside. Public authorities may have limited influence over the operation of systems that become essential for service delivery. The World Health Organization's digital health strategy emphasises the need for coordinated governance and interoperability. The European Health Data Space provides a further example of attempts to establish common rules for exchanging information across national systems.

These approaches indicate that technological coordination requires legal and organisational agreements. For TEOS 2100, the governance of digital infrastructure would be relevant to maintaining continuity of services across geographical boundaries. Possible arrangements could include shared technical standards, public oversight and agreements concerning access to essential records. However, no single technological architecture can resolve all questions of jurisdiction, financing or accountability.

Technology and inequality under changing settlement patterns

Technological systems may create advantages for individuals able to access them while reinforcing disadvantages for others. People with reliable connectivity, digital literacy and recognised qualifications may benefit from remote employment and online services. Those without these resources may encounter additional barriers.

Digital systems can also shift costs from institutions to individuals. Accessing an online service may require purchasing a device, paying for connectivity or maintaining a digital account. For lower-income households, these requirements can be substantial. Where public

[175] World Health Organization (WHO) (2024). *Ethics and Governance of Artificial Intelligence for Health: Guidance on Large Multi-modal Models*. Geneva: WHO. ISBN 978-92-4-008475-9. https://www.who.int/publications/b/70584

services increasingly rely on digital access, people who remain offline may become less visible to institutions.

For TEOS 2100, technological development should therefore be examined as a possible source of inequality as well as an instrument for reducing it. The relevant question is not whether digital services become more widespread. It is whether they remain accessible to people with different economic resources, levels of literacy, disabilities and patterns of residence. The existence of nondigital alternatives may remain necessary even where digital technologies become widely available.

Institutional principles for technology in a post-settlement future

The examples discussed in this chapter identify several technological functions relevant to a possible Post-Settlement Civilisation. Digital communication can support social relationships across locations. Remote employment may allow some households to diversify livelihoods. Electronic records can improve continuity in education and healthcare. Digital identity systems may simplify administrative procedures. Environmental monitoring can inform decisions concerning adaptation, evacuation and settlement viability.

However, these functions depend on physical infrastructure, legal recognition and institutional accountability. For TEOS 2100, five principles provide a basis for evaluating technological arrangements.

Accessibility concerns the ability to obtain essential information and services regardless of income, connectivity or digital skills.

Interoperability concerns the recognition and exchange of relevant information between institutions and jurisdictions.

Resilience concerns the continued availability of essential functions during infrastructure disruptions.

Protection of rights concerns privacy, accountability and the prevention of discriminatory or arbitrary decisions.

Institutional responsibility concerns maintaining human oversight, adequate financing and clear legal authority for decisions affecting individuals.

These principles are proposed as an analytical framework for TEOS 2100. They do not describe an existing technological system capable of supporting an entire post-settlement society.

Implications for TEOS 2100

Technology can influence the relationship between people and places, but it does not eliminate the environmental and institutional conditions on which livelihoods depend. Digital nomadism demonstrates that some forms of employment can be organised across different locations.

Telemedicine and electronic health records can improve continuity of care, provided that the necessary healthcare institutions remain available. Digital learning systems can support educational participation during movement, although teaching and recognition of qualifications continue to require institutional responsibility.

Environmental monitoring can improve knowledge of physical risks and potentially support adaptation decisions. The Gyirong-Rasuwa disaster of August 2026 demonstrates both the value of advanced observations and the consequences of insufficiently integrated warning systems.

For TEOS 2100, the possible role of technology is therefore broader than facilitating mobility. It may help communities remain in existing settlements, support planned movement where necessary and maintain access to services after relocation. However, its benefits are neither automatic nor equally distributed. Infrastructure gaps, financial constraints, legal barriers and concerns about privacy can limit access or create new vulnerabilities.

A Post-Settlement Civilisation should not be conceived as a society in which digital systems replace geographical and political institutions. It would still require physical infrastructure, public services and legitimate authorities responsible for protecting rights. The relevant technological development would be the capacity to maintain continuity across changing locations without requiring permanent digital surveillance or excluding those unable to participate online.

Such systems could support more flexible forms of residence and economic activity. Their contribution would depend on how effectively technological capabilities are connected to the institutional principles examined throughout Chapter 5. Technology would therefore be one component of a possible post-settlement framework, rather than the determining force behind its emergence.

6. Four Futures of 2100

6.1 Scenario Framework and Methodology

The preceding chapters have examined environmental change, the potential limits of settlement and the institutions through which societies might respond to changing conditions. The analysis identifies several developments that could influence the future distribution of population and economic activity.

Changes in water availability, glacial systems, agricultural productivity and exposure to natural hazards may affect the viability of existing settlements. These pressures interact with economic opportunities, infrastructure, resource governance and political decisions.

The consequences will differ between locations. Some settlements may remain viable through adaptation and investment. Others may experience a gradual deterioration of living conditions, increasing costs or more frequent interruptions to essential services. The resulting patterns of human mobility will also vary. People may remain in their communities, move temporarily, establish livelihoods across several locations or relocate permanently.

None of these responses can be assumed to become the dominant form of human settlement by 2100. For TEOS 2100, the question is therefore not which single future will emerge. It is how different political, economic and institutional responses to environmental change could shape the conditions under which people live.

This chapter explores four alternative futures: *Fortress Earth*, *Negotiated Mobility*, *Networked Nomads* and *Planetary Transition*. They are not forecasts of the world in 2100. They are structured explorations of how different forms of governance and social organisation might respond to the pressures examined in this report.

The purpose of scenario analysis

Long-term futures research must account for uncertainty. Scientific observations and models can provide evidence concerning environmental processes. They can also support projections under specified assumptions. However, the development of political institutions, economic relationships and social practices depends on decisions and events that cannot be predicted with comparable precision.

Scenario analysis offers a way to examine these uncertainties without presenting one possible outcome as inevitable. The Intergovernmental Panel on Climate Change defines a scenario as a plausible description of future development based on a coherent and internally consistent set of assumptions about important driving forces and their relationships. Scenarios are used to explore the implications of different developments and actions. They are not predictions or forecasts.[176]

[176] Intergovernmental Panel on Climate Change (IPCC) (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Working Group II Contribution to the Sixth Assessment Report, Annex II: Glossary, entry “Scenario”. Cambridge: Cambridge University Press. https://www.ipcc.ch/report/ar6/wg2/chapter/annex-ii/

The United Kingdom's Government Office for Science similarly describes exploratory scenarios as tools for examining alternative futures and testing decisions against uncertainty. Its *Futures Toolkit* outlines a method in which two critical uncertainties are combined to generate four contrasting scenarios.[177]

The United Nations Development Programme also uses this approach in its guidance on strategic foresight. The method is intended to make the relationships between assumptions, institutional choices and possible outcomes explicit.[178]

TEOS 2100 adopts this exploratory approach. The scenarios are qualitative constructions grounded in the evidence and institutional examples examined in Chapters 1-5. They are not outputs of a new climate model, population simulation or integrated assessment model. They do not assign probabilities to the four futures.

Their purpose is to examine how different social and political arrangements might affect the ability of people to maintain secure lives under changing environmental conditions.

A common environmental starting point

The four scenarios begin with a shared set of environmental and socioeconomic pressures. The Hindu Kush Himalayan region is used as the principal geographical reference. Its river systems, mountain communities, agricultural economies and connections to downstream populations make it an important setting for examining changes in settlement viability.

The preceding chapters identified several processes relevant to this question. Glacier retreat, changes in snow and ice storage, variable runoff, extreme precipitation and mountain hazards may affect water security and infrastructure. Agricultural and economic conditions may change as access to resources becomes less reliable. Population movements may place additional demands on receiving regions.

These processes can interact, but they will not occur uniformly across the region or follow a single timetable. For the purposes of scenario development, TEOS 2100 assumes that environmental pressures continue to affect settlement viability in different parts of the Hindu Kush Himalayan region during the twenty-first century. This is a common condition for exploring institutional responses. It does not mean that all settlements become uninhabitable or that all four scenarios experience identical environmental losses. The severity and geographical distribution of impacts remain dependent on climate developments, local conditions and adaptation.

The IPCC's Sixth Assessment Report identifies climate-resilient development as a process through which adaptation, mitigation and sustainable development can influence future

[177] Government Office for Science (2024). *The Futures Toolkit: Tools for Strategic Futures for Policymakers and Analysts*. Updated edition, 29 August 2024. London: UK Government. https://www.gov.uk/government/publications/futures-toolkit-for-policy-makers-and-analysts/the-futures-toolkit-html

[178] United Nations Development Programme (UNDP) (n.d.). *Foresight in Country Programme Documents Toolkit*, Chapter 2: Developing Scenarios. https://www.undp.org/foresight-in-CPD-toolkit/chapter-2

outcomes. It also recognises that the feasibility and effectiveness of adaptation vary across sectors, regions and communities.[179]

For TEOS 2100, this means that settlement viability is not determined by environmental exposure alone. It is influenced by infrastructure, available resources, economic investment and institutional decisions. The scenarios explore how societies might respond to these pressures rather than assuming that environmental change automatically produces one social order.

Two critical uncertainties

The four scenarios are organised around two dimensions of uncertainty. The first concerns the organisation of governance and access to rights. The second concerns the dominant approach to maintaining livelihoods and social participation under changing settlement conditions. These dimensions are related, but they address different questions.

Governance: from territorial exclusion to coordinated inclusion

At one end of this dimension, states and other authorities give priority to territorial control and restrict access to resources, residence and public services according to membership or legal status. At the other end, institutions develop stronger arrangements for cooperation, participation and the recognition of rights across jurisdictions.

These positions describe broad tendencies rather than absolute conditions. Even highly restrictive systems may retain some international cooperation. Similarly, cooperative systems may preserve national borders, citizenship requirements and restrictions on particular forms of mobility.

The relevant uncertainty concerns the extent to which institutions provide predictable, inclusive access to rights and resources when populations and economic activities extend across established boundaries.

Social organisation: from place-based adaptation to mobility-based adaptation

At one end of this dimension, households, communities and governments place greater emphasis on preserving the viability of existing settlements through infrastructure, resource management and local economic adaptation. At the other end, mobility and multi-local livelihoods become more prominent means of maintaining economic activity, public services and social relationships.

These approaches are not mutually exclusive. A society centred on place-based adaptation will still contain migration. A society characterised by extensive mobility will still depend on permanent settlements, fixed infrastructure and stable institutions.

[179] Intergovernmental Panel on Climate Change (IPCC) (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Summary for Policymakers, Section D: Climate Resilient Development. Cambridge: Cambridge University Press. https://www.ipcc.ch/report/ar6/wg2/chapter/summary-for-policymakers/

The uncertainty concerns which forms of adaptation become more influential in organising everyday life. The two dimensions create four contrasting combinations.

Figure 6. Four alternative futures for 2100, defined by different approaches to governance and social adaptation.

The scenarios are exploratory and do not represent predictions or mutually exclusive global outcomes. Source: TEOS 2100, own conceptual framework (2026).



The four futures

Fortress Earth combines predominantly territorial and exclusionary governance with a strong preference for protecting established settlement systems and allocating resources according to controlled membership. States and other powerful institutions seek to preserve selected locations through strict regulation of mobility, land and essential resources. Access to secure living conditions becomes increasingly unequal. Mobility continues, but it is constrained and may expose people without recognised rights to substantial insecurity.

Negotiated Mobility combines coordinated and relatively inclusive governance with an increased reliance on migration, circular movement and multi-local residence. States retain their sovereignty while developing agreements concerning admission, employment, social protection and shared resources. Mobility becomes an organised element of adaptation rather than being managed primarily through emergency responses. The central challenge is maintaining political cooperation and distributing responsibilities fairly.

Networked Nomads combines extensive mobility with fragmented and unevenly inclusive governance. Employment, access to services and social relationships are increasingly organised through digital platforms, private organisations and transnational networks. Some individuals gain considerable flexibility. Others remain dependent on temporary legal status, commercial systems or employers controlling access to essential services. Economic

integration may extend across borders without corresponding political representation or social protection.

Planetary Transition combines coordinated and inclusive governance with a greater emphasis on preserving and restoring the viability of settlements. Governments, communities and other institutions invest in adaptation, ecological regeneration and shared resource management. Mobility remains available where required, but the ability to maintain secure livelihoods in existing communities receives sustained attention. The scenario examines whether institutional cooperation and long-term investment could reduce avoidable displacement while expanding access to viable living conditions.

None of these futures is intended as a complete description of all societies in 2100. Each represents a distinct configuration of institutions, adaptation practices and access to resources.

Why four scenarios?

The four-scenario structure provides a manageable basis for comparison. It allows the report to explore different combinations of governance and adaptation without assuming that every possible future must be represented by a separate narrative. A larger number of scenarios could accommodate additional uncertainties. However, it could also make the underlying differences less clear and reduce the depth with which individual futures are examined.

The selected scenarios address four questions.

1. What might happen if environmental pressures encourage territorial exclusion?
2. How could international and regional cooperation support secure mobility?
3. What would extensive mobility mean where economic networks develop faster than legal protection?
4. Could coordinated adaptation maintain viable settlements while protecting the option to move?

These questions provide contrasting perspectives on the same underlying concern. They also allow the report to examine the advantages and limitations of different institutional arrangements.

The selection of four scenarios does not imply that all possible futures fall neatly into one category. Real developments may combine elements of several scenarios or move between them over time. The scenario framework is therefore an analytical tool, not a classification of future societies into fixed types.

From present conditions to 2100

Each scenario is developed through a possible sequence of institutional and social changes between 2026 and 2100. Four broad periods provide a common chronological structure:

2026-2040	Emerging pressures, policy choices and institutional responses.
2041-2060	Consolidation or revision of initial approaches.

2061-2080	Consequences for economic systems, population distribution and institutional relationships.
2081-2100	The resulting social and institutional conditions examined in each scenario.

These periods are organisational devices. They do not represent scientifically established thresholds or dates at which particular social developments are expected to occur. The scenarios do not assume that institutional change proceeds smoothly or that early decisions determine later outcomes without interruption.

Political agreements may fail or be revised. Technologies may develop more slowly than anticipated. Communities may resist relocation, adopt new livelihoods or develop institutional arrangements that were not previously considered. The chronological structure is used to explore possible relationships between decisions and their longer-term consequences.

It should not be interpreted as a prediction of when specific events will occur.

A common basis for comparison

To ensure consistency, all four scenarios are examined against the same institutional and human conditions. The environmental foundation is drawn from the evidence discussed in Chapters 2-4. The institutional dimensions build on the six areas developed in Chapter 5: governance, education, economic systems, social cohesion, mobility and technology.

Within each scenario, the analysis addresses the following questions.

Settlement and resource access. Which locations remain viable, and how are housing, land, water and essential infrastructure made available?

Governance and rights. Who makes decisions, whose interests are represented and how can individuals assert their rights?

Education and healthcare. Can people maintain access to essential services when their location or legal status changes?

Livelihoods and economic security. What opportunities exist for employment, income generation and social protection?

Mobility and residence. Can people remain where they live, move temporarily or relocate without losing essential rights?

Social belonging. How are relationships maintained between established populations, newcomers and communities extending across several locations?

Technology and infrastructure. Which technical systems support these functions, and what happens when they fail or become inaccessible?

These questions are intended to make the scenarios comparable. They also prevent the analysis from being driven primarily by technological innovation or political institutions without considering their consequences for everyday life.

Human viability as the central test

The focus of TEOS 2100 is not simply whether settlements continue to exist. A location may remain physically habitable while providing inadequate access to water, food, employment or essential services. Similarly, a population may be able to move across borders while lacking the rights needed to establish a secure livelihood.

For this reason, the scenarios are assessed through the conditions under which people can live. The analysis considers whether individuals and households can obtain essential resources, maintain income, access education and healthcare, participate in decisions and preserve meaningful social relationships.

It also considers the ability to make choices:

- Can people remain in a community when they wish to do so and environmental conditions permit?
- Can they move when continued residence becomes unsafe or economically untenable?
- Can they maintain relationships with places of origin while participating in another community?

These questions connect the environmental analysis to the institutional arrangements examined in Chapter 5. They also create the basis for the Human Stories presented in Chapter 7.

Inequality within scenarios

A scenario does not describe a single human experience. Even within the same political and economic system, people may encounter different opportunities and restrictions. Citizens and non-citizens may have different rights. Property owners and tenants may experience changes in settlement viability differently. Workers with recognised qualifications may have greater mobility than people whose livelihoods depend on local natural resources. Women, children, older people and individuals with disabilities may face different barriers depending on institutional and household arrangements.

For TEOS 2100, these differences are not secondary details. They influence whether an institutional system can provide secure living conditions for the people subject to it. Each scenario therefore examines not only the operation of its institutions but also the distribution of their benefits and costs.

The central question is not whether a future society is prosperous, cooperative or technologically advanced in general terms. It is who can participate in its advantages and who remains excluded. This approach prevents the scenarios from becoming simplified descriptions of desirable and undesirable futures.

- *Planetary Transition*, for example, may face conflicts over land rights and the costs of adaptation.
- *Negotiated Mobility* may contain disputes over responsibility for receiving populations.
- *Networked Nomads* may provide flexibility while leaving some workers with inadequate protection.
- Even *Fortress Earth* may provide stability and services for selected populations, despite substantial inequalities elsewhere.

These tensions must remain visible in the scenarios.

Regional focus and wider implications

The Hindu Kush Himalayan region provides the geographical starting point for TEOS 2100. However, the implications of changing settlement conditions may extend beyond the region. River systems connect mountain environments with downstream populations and economies.

Trade, labour migration and remittances create relationships between countries within and beyond Asia. Energy infrastructure, agricultural production and transport networks link local environmental conditions to wider economic systems. International institutions influence migration, climate cooperation and access to resources.

The scenarios therefore consider both regional developments and their wider consequences. This does not mean that the entire world must follow one institutional pathway. Different regions may develop different responses to comparable environmental pressures.

An exclusionary political system could exist alongside a cooperative regional mobility arrangement. A digitally connected labour market could span jurisdictions with very different approaches to citizenship and public services.

For the purposes of comparison, each scenario presents a coherent dominant development pattern. The possibility that elements of several scenarios coexist is acknowledged but does not replace the analytical distinction between the four models.

Relationship to the Human Stories

Chapter 7 translates the institutional conditions examined here into individual experiences. Two fictional perspectives are associated with each of the four scenarios. The purpose is not to provide evidence that a scenario will occur.

The stories are narrative thought experiments constructed from the conditions specified in the preceding analysis. They examine how a person's opportunities and decisions might be shaped by institutions, resource access, employment and social relationships. Each story centres on a concrete situation requiring a decision.

The consequences of that decision depend on the institutional conditions of the relevant scenario. For example, a teacher working with mobile children may face different choices depending on whether mobility is restricted, legally coordinated or supported primarily

through digital networks. A family deciding whether to remain in an environmentally exposed settlement may encounter different financial and legal conditions under each future.

These narrative cases provide an additional test of internal consistency. If a scenario cannot explain how people obtain essential services, maintain livelihoods or exercise recognised rights, its institutional assumptions require further examination.

The stories do not establish empirical findings. Their function is to make the implications of each scenario understandable and to identify questions that may remain obscured in a predominantly institutional analysis. Although the stories can also provide material for a separate fictional adaptation, the report maintains a distinction between scenario analysis and narrative invention.

Methodological limitations

The scenario framework has several limitations.

First, the four futures are qualitative and exploratory. They are not generated by a probabilistic model and should not be interpreted as estimates of the likelihood of particular political or social developments.

Second, the relationships between environmental change, population movement and institutional responses are complex. A change in one factor does not necessarily produce a predictable change in another.

Third, the two dimensions used to construct the scenarios simplify a wider range of uncertainties. Technological development, geopolitical relationships, demographic change and economic inequality may influence outcomes in ways that cannot be fully represented by a two-dimensional matrix.

Fourth, the geographical diversity of the Hindu Kush Himalayan region limits the extent to which a single narrative can represent all countries and communities. The scenarios therefore describe contrasting development patterns rather than uniform regional conditions.

Finally, the narrative cases in Chapter 7 are fictional. They are used to examine the consequences of scenario assumptions, not to provide evidence for those assumptions. These limitations do not eliminate the value of scenario analysis. They establish the boundaries within which its findings should be interpreted.

Implications for TEOS 2100

The four futures developed in this chapter examine how environmental pressures could interact with different political and social responses.

- *Fortress Earth* explores the consequences of territorial exclusion and unequal resource access.
- *Negotiated Mobility* examines institutional cooperation that allows people to move while maintaining recognised rights.
- *Networked Nomads* considers economically connected populations whose mobility and access to services depend heavily on networks and digital systems.

- *Planetary Transition* examines whether cooperative governance and sustained adaptation could preserve or restore viable settlements while protecting mobility as an option.

The scenarios are not competing predictions. They provide different perspectives on the institutional conditions under which people may live in 2100. Their comparison is intended to clarify the implications of present and future choices rather than identify one predetermined destination.

The assessment places human living conditions at the centre. A future cannot be considered viable merely because it maintains territorial control, economic activity or sophisticated technology. Its institutions must also be assessed according to the opportunities and protections available to people. The following sections explore each of the four futures in greater detail.

6.2 Fortress Earth

Fortress Earth describes a future in which environmental insecurity reinforces territorial control, political exclusion and unequal access to essential resources.

As the viability of some settlements declines, governments respond by concentrating investment and public protection in selected locations. Borders become more restrictive, access to public services depends increasingly on recognised residence, and mobility is managed primarily as a matter of national security.

This scenario does not assume that all states become authoritarian or that international cooperation disappears. It examines a development pattern in which territorial protection takes precedence over the broader coordination of rights and resources.

Some institutions remain functional and technologically advanced. However, their benefits are distributed unequally. Protected urban centres may continue to provide reliable water supplies, energy, healthcare and education to recognised residents. People outside these areas may face deteriorating services, insecure livelihoods and restrictions on movement.

The defining characteristic of Fortress Earth is therefore not the absence of settlement. It is the unequal protection of settlement viability.

Environmental pressures and territorial responses

The environmental conditions examined in Chapters 2-4 provide the starting point for this scenario. Changes in snow and glacier systems, more variable river flows and increasing exposure to mountain hazards may affect water security, infrastructure and agricultural livelihoods. The effects will vary across the Hindu Kush Himalayan region. Some areas may remain viable through investment and adaptation. Others may experience increasing costs, interruptions to essential services or declining economic opportunities.

The ICIMOD *HKH Snow Update 2026* reported that snow persistence across the region was 27.8 per cent below the long-term average, the lowest level in the available 24-year record. It was the fourth consecutive year of below-average snow persistence. The report identified

possible consequences for river flows, agriculture, hydropower and water availability during the months preceding the monsoon.[180]

This observation does not establish a continuous decline towards 2100 or prove that particular settlements will become uninhabitable. However, it illustrates the variability and uncertainty that water-management institutions must already address. In Fortress Earth, governments increasingly interpret such pressures through the lens of territorial security.

Rather than prioritising shared adaptation and access, they seek to protect selected areas considered essential to national stability and economic activity. Water infrastructure, transport corridors and energy systems become objects of strategic protection. Access to these systems may depend on citizenship, residence or other forms of recognised membership. The political response becomes as important as the environmental pressure itself.

Existing tensions over transboundary resources

The Hindu Kush Himalayan region contains river systems that connect several countries. Water management therefore involves questions of sovereignty, infrastructure and competing economic interests. These issues already exist and do not arise solely from climate change.

The Indus Waters Treaty of 1960 provides an example of an institutional arrangement designed to manage a major transboundary river system. The agreement allocates the waters of the Eastern Rivers principally to India and those of the Western Rivers principally to Pakistan, subject to specified uses and obligations.

It also establishes procedures for addressing disagreements. The treaty has experienced significant political tensions. Following the terrorist attack in Pahalgam in April 2025, India announced that it would hold the treaty in abeyance.

In an award issued on 31 August 2026, a Court of Arbitration operating with the Permanent Court of Arbitration as its secretariat concluded that the treaty remained legally in force and that India's unilateral decision had not suspended its operation. India rejected the award, disputed the tribunal's jurisdiction and maintained that its decision to place the treaty in abeyance remained effective.[181]

The disagreement illustrates the difficulties that can arise when international legal procedures and national political positions diverge. It does not demonstrate that armed conflict over water is inevitable. Nor does it establish that international agreements necessarily become ineffective under environmental pressure.

[180] Muhammad, S. (2026). *HKH Snow Update 2026*. International Centre for Integrated Mountain Development (ICIMOD), Kathmandu. https://doi.org/10.53055/ICIMOD.1127

[181] Permanent Court of Arbitration (2026). *Indus Waters Western Rivers Arbitration (Islamic Republic of Pakistan v. Republic of India), Award on the Status of the Indus Waters Treaty in Respect of India's Decision on Abeyance*, 31 August 2026. https://pca-cpa.org/en/cases/284/. See also Government of India, Ministry of External Affairs (2026). *Matters Pertaining to the Illegally-Constituted So-Called Court of Arbitration*, 31 August 2026. https://www.mea.gov.in/

For Fortress Earth, the example is relevant as a possible starting condition. The scenario explores what could happen if governments increasingly treat water arrangements as instruments of strategic control and become less willing to accept external dispute-resolution mechanisms.

Climate change and the risk of conflict

The relationship between environmental change and violent conflict requires careful interpretation. The IPCC's Sixth Assessment Report identifies climate change as a factor that can influence conflict through livelihood insecurity, economic losses, unequal resource access and other mechanisms.

However, it also finds little observed evidence that climate variability or climate change directly causes violent conflict between states. Political institutions, economic inequality and existing disputes strongly influence whether environmental pressures contribute to violence.[182]

This distinction is fundamental to Fortress Earth. The scenario is not based on the assumption that declining water availability automatically produces war. Instead, it examines a possible political response in which governments use environmental insecurity to justify increasingly restrictive measures.

Such measures might include tighter border controls, privileged access to infrastructure and expanded surveillance. They could also involve reduced participation by communities affected by resource-management decisions. These developments may reinforce distrust and competition. However, they would arise through political decisions and institutional change rather than through environmental pressures alone.

2026-2040: Security becomes a priority in resource governance

In the first period, governments face growing demands to adapt infrastructure, manage environmental hazards and maintain access to essential resources. Public investment remains possible, but decisions increasingly reflect security priorities. Major urban centres, strategic transport corridors and economically important production areas receive attention because of their role in national stability.

Other settlements may struggle to obtain comparable support. The distinction between protecting infrastructure and protecting people becomes increasingly important. A government may invest heavily in a reservoir, power station or transport route while providing limited assistance to communities affected by the associated land use or changing resource allocation.

Border management also becomes more closely connected to environmental and economic planning. Governments may seek to control movement into areas where housing, employment and public services are under pressure. Temporary labour migration may

[182] Intergovernmental Panel on Climate Change (IPCC) (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Working Group II Contribution to the Sixth Assessment Report, Chapter 7: Health, Wellbeing and the Changing Structure of Communities, Sections 7.2.7 and 7.3.3. https://www.ipcc.ch/report/ar6/wg2/chapter/chapter-7/

remain possible, but permanent residence and access to social benefits become more selective.

These developments would not necessarily involve a sudden break with existing institutions. They could emerge through successive policy decisions that appear individually justified by budget constraints, infrastructure protection or public security. Over time, their cumulative effect could produce increasingly unequal access to viable places. The Indus Waters Treaty dispute of 2025-2026 illustrates the type of political disagreement that could complicate regional cooperation.

In Fortress Earth, similar disputes become more difficult to resolve because governments place greater emphasis on unilateral decisions. This does not require all treaties to collapse.

Some agreements may remain in force while implementation becomes more contested or cooperation narrows to limited technical matters.

2041-2060: Settlement protection becomes increasingly selective

During the second period, differences between settlements become more pronounced. Locations with reliable infrastructure, employment and access to essential resources attract additional population and investment. Other areas experience economic decline or increasing costs associated with environmental hazards. Public authorities face difficult decisions concerning the distribution of adaptation resources.

In Fortress Earth, these decisions favour settlements considered economically or strategically important. Protected cities and industrial regions may receive investments in water treatment, flood protection, energy supply and transport. Less influential communities may receive limited assistance or be encouraged to relocate without adequate financial support.

The resulting inequalities affect property and livelihoods. Households owning property in protected regions may benefit from public investment and increasing demand. Households in environmentally exposed areas may experience falling property values or lose access to productive land. These effects correspond to the economic risks examined in Chapter 5.3.

Population redistribution may also place pressure on receiving settlements. Rather than responding primarily through inclusive planning, authorities may impose more restrictive residence and registration requirements. People without recognised status may be able to work temporarily while facing limits on housing, education or healthcare.

Informal settlements may develop where economic demand for labour continues but access to formal residence remains constrained. The distinction between economic participation and recognised social membership becomes a defining feature of the scenario.

Water, energy and food as connected systems

Access to water, energy and food is closely interconnected. Agricultural production depends on water and energy. Energy infrastructure may depend on river flows, fuel supply and transport. Food distribution requires functioning roads, markets and storage facilities.

Disruption in one system can affect the others. The *Hindu Kush Himalaya Assessment* documents the importance of these relationships for regional development and water security. It also identifies the influence of governance, infrastructure and environmental change on access to resources.[183]

In Fortress Earth, governments seek to protect critical systems through increasingly centralised allocation. Priority may be given to strategic industries, designated urban centres or essential government services. Other users may face restrictions or reduced reliability.

This does not necessarily mean that all resources become privately owned. State control, public ownership and private concessions can coexist within a restrictive allocation system. The defining feature is that access depends increasingly on political and administrative decisions that offer limited protection to excluded groups.

A household may experience the consequences through water rationing, unreliable electricity or higher prices for essential goods. A farmer may lose irrigation access while nearby infrastructure continues supplying an industrial area. The pressure on livelihoods arises not only from total resource availability but also from the rules governing distribution.

2061-2080: Unequal access becomes institutionalised

In the third period, the inequalities established earlier become more deeply embedded in administrative and economic systems. Protected settlements have developed infrastructure that enables them to withstand some environmental pressures. They may possess reliable energy systems, advanced water treatment and digital public services.

However, access is linked to recognised residence, employment status or other eligibility requirements. People living outside designated areas may depend on less reliable infrastructure or temporary arrangements. Movement between locations becomes more tightly regulated. Border crossings, internal registration requirements and access to strategic infrastructure may involve extensive administrative controls.

Digital identification systems can make these restrictions easier to enforce. As discussed in Chapter 5.6, digital technologies can support continuity of rights but can also enable surveillance and exclusion.

In Fortress Earth, their principal function increasingly shifts towards identifying authorised users and controlling access. For example, a person may possess a valid work permit for one district without having the right to reside or obtain services elsewhere. A household may be entitled to subsidised water in its registered municipality but not in another location.

Such arrangements could create a society in which administrative status strongly influences everyday security. The technology itself does not require these outcomes. They result from the political rules governing its use.

[183] Wester, P., Mishra, A., Mukherji, A., & Shrestha, A. B. (Eds.) (2019). *The Hindu Kush Himalaya Assessment: Mountains, Climate Change, Sustainability and People*. Springer International Publishing. https://doi.org/10.1007/978-3-319-92288-1

The changing meaning of citizenship and residence

Citizenship traditionally establishes a legal relationship between individuals and states. However, access to particular services also depends on residence, employment and administrative eligibility. Chapter 5.1 examined the possibility of extending certain rights across jurisdictions. Fortress Earth explores the opposite tendency. Governments may preserve formal citizenship while attaching an increasing range of practical benefits to specific territorial or administrative categories.

A citizen living outside a protected settlement may possess political rights but lack reliable access to infrastructure. A migrant worker may contribute economically while remaining excluded from particular public benefits. People displaced by environmental deterioration may face difficulties establishing recognised residence in a receiving region. This creates a distinction between legal membership and the practical ability to secure a livelihood.

The scenario does not require states to abolish existing rights. Instead, access to essential services becomes increasingly conditional, and mechanisms for challenging exclusion may weaken. For TEOS 2100, this is one of the principal risks of a territorially restrictive response to environmental change.

Economic life in protected and peripheral settlements

Fortress Earth would not necessarily produce a uniformly impoverished society. Protected regions could remain economically productive. Infrastructure investment, advanced manufacturing and digital technologies may support employment and public revenue. However, the distribution of these benefits would be unequal. Workers with recognised residence and professional qualifications may obtain secure employment. Others may depend on temporary contracts, informal markets or employment linked to restrictive permits.

The economic relationship between protected centres and peripheral settlements could become increasingly asymmetric. Protected regions may rely on agricultural products, raw materials and labour originating outside their boundaries. At the same time, people in supplying regions may have limited access to the services and infrastructure concentrated in protected centres. This creates a form of economic interdependence without equivalent political or social inclusion.

The World Bank's research on forced displacement demonstrates that social tensions can intensify where receiving communities face strained public services and limited economic opportunities. It also finds that inclusive policies and development investment can reduce these tensions.[184]

Fortress Earth explores a setting in which such inclusive responses are insufficient or increasingly subordinated to territorial priorities. Under these conditions, economic inequality may become a continuing source of distrust between communities.

[184] World Bank (2023). *Social Cohesion and Forced Displacement: A Synthesis of New Research*. Washington, DC: World Bank. https://data.unhcr.org/en/documents/details/99136

Education and healthcare under selective protection

Education and healthcare remain available in Fortress Earth, but access differs substantially between population groups. Protected settlements may maintain well-equipped schools, hospitals and digital services. Children living in these areas may benefit from stable enrolment and recognised educational records. Children in temporary settlements may face interruptions because of residence restrictions, insufficient facilities or frequent movement.

A mobile teacher may be able to provide instruction but lack permission to operate outside an assigned district. Students may have completed learning activities that receiving institutions refuse to recognise. These difficulties would reflect institutional restrictions rather than the absence of educational technology.

Healthcare could develop along similar lines. Electronic records and remote consultations may be widely used in protected areas. People without recognised eligibility may nevertheless struggle to obtain treatment. They may possess medical information but lack entitlement to services or affordable transport to appropriate facilities.

The distinction between technological capability and effective access, examined in Chapters 5.2 and 5.6, becomes central. A society may possess sophisticated public-service systems while providing unequal protection to the people living within its economic and political reach.

The persistence of informal and mobile societies

Even under restrictive territorial governance, mobility would not disappear. People may continue to move in search of employment, family support or safer living conditions. Some movements may be authorised through temporary permits. Others may occur without formal recognition.

Existing pastoral and multi-local communities could face difficulties maintaining customary access to land and resources where movement becomes more tightly regulated. Seasonal grazing routes may intersect with protected infrastructure zones or administrative boundaries. Traditional resource-use rights may become contested where governments place greater emphasis on territorial control. Chapter 4.4 examined how customary and communal arrangements can regulate access without exclusive ownership.

In Fortress Earth, such systems may be weakened where central authorities replace negotiated resource access with unilateral allocation. However, customary institutions would not necessarily disappear. Some communities may retain local arrangements, while others adapt their practices to changing restrictions. The resulting picture is one of uneven institutional development rather than complete social collapse.

2081-2100: A territorially divided society

By the final period, the scenario has developed into a social order in which the protection of selected settlements shapes governance, infrastructure and political membership. Environmental change continues to affect different locations, but access to adaptation has become highly unequal.

Some cities and production regions remain viable through sustained investment. Their residents may enjoy stable water supplies, employment and essential services. Other populations live in settlements with limited infrastructure or maintain livelihoods through temporary movement. Movement remains necessary for many households, but opportunities depend heavily on legal status and administrative permission.

Formal borders continue to define state sovereignty. Within states, distinctions between protected and peripheral locations may become equally influential. These conditions affect the daily decisions of individuals.

A family may wish to relocate to a safer settlement but lack the documents required for residence. A worker may accept employment in a protected industrial region while leaving family members in an area with inadequate services. A teacher may face a choice between remaining within an authorised district and travelling to reach children who cannot attend formal schools.

The central characteristic of this future is the contrast between advanced protective capacity and unequal access to its benefits. Fortress Earth is not a world in which adaptation has failed everywhere. It is a world in which adaptation has become selective.

The role of international institutions

International organisations would continue to exist in some form within this scenario. However, their capacity to coordinate responses could become more limited. States may maintain membership in the United Nations while resisting agreements perceived as restricting national control over resources or migration. Regional cooperation could continue in areas where governments identify immediate mutual benefits.

Nevertheless, broader arrangements for mobility and shared resource governance may remain weak or difficult to enforce. The legal developments concerning the continuity of statehood, examined in Chapter 5.1, demonstrate that international law can adapt to environmental change.

Fortress Earth explores a future in which such legal recognition does not necessarily translate into effective protection for mobile populations. Existing states may preserve their sovereignty and international representation while individuals displaced within or between their territories experience increasingly restricted rights.

International organisations may provide technical assistance and humanitarian support. However, the distribution of essential resources remains dominated by national or subnational authorities. The resulting weakness is not necessarily the disappearance of international law. It is the gap between formal legal commitments and practical access to protection.

Conflict prevention under conditions of exclusion

The institutions of Fortress Earth may provide stability for protected populations while increasing insecurity elsewhere. Restricted access to water, land and employment can create grievances. Communities may challenge decisions concerning infrastructure or

resource allocation. Tensions may develop between recognised residents and incoming populations.

However, these disputes do not necessarily escalate into organised violence. The IPCC emphasises the importance of political and socioeconomic conditions in determining whether environmental pressures contribute to conflict. The World Bank's research on social cohesion similarly identifies inclusive services, institutional trust and development investment as factors that can reduce tensions.

In Fortress Earth, these mechanisms are weakened by selective access and limited participation. Conflict prevention may increasingly rely on enforcement rather than negotiation. Such approaches may control particular disputes in the short term while leaving their underlying causes unresolved.

For TEOS 2100, the key question is whether a system that provides stability through exclusion can remain socially and economically viable over long periods. The scenario does not assume a definitive answer. It explores the tensions created when governments protect selected settlements without providing comparable opportunities for populations outside them.

Human Implications

In Fortress Earth, the conditions of everyday life depend strongly on where people are permitted to live and which rights their administrative status provides. A recognised resident of a protected city may have access to reliable water supplies, electricity, healthcare and education. Public infrastructure offers protection against environmental hazards, and digital systems simplify access to services. For those outside protected areas, the same technologies may function as instruments of restriction. Water allocations, employment permits and residence rights can determine whether a household is able to remain in a particular location.

The division affects work, family life and social relationships. A mobile educator may be responsible for children whose families follow seasonal livelihoods but whose movements cross administrative boundaries. Her work requires access to water, transport and recognised teaching rights.

At the same time, a resident of a protected settlement may depend on services and labour supplied by communities excluded from equivalent protection. Neither person necessarily controls the institutions shaping their decisions. The two fictional perspectives developed in Chapter 7 examine how such unequal conditions influence individual choices, responsibilities and opportunities.

Implications for TEOS 2100

Fortress Earth represents a possible institutional response to environmental insecurity rather than a prediction of political collapse. Its central assumption is that governments and other powerful actors respond to increasing pressure on settlements and resources through territorial control and selective protection. Some locations remain economically productive

and technologically advanced. Others experience declining investment, limited services and restricted access to the opportunities offered by protected regions.

Mobility continues but becomes increasingly dependent on permission and recognised status. The scenario illustrates how environmental pressure could interact with existing inequalities and political decisions to produce a divided settlement system. It also demonstrates the limits of evaluating adaptation solely through the survival of infrastructure or the continued economic performance of selected locations. A protected city may remain viable while populations outside its boundaries experience deteriorating living conditions.

For TEOS 2100, the relevant question is therefore whose settlement viability is being preserved and under which conditions. The risks illustrated by Fortress Earth are not inevitable consequences of climate change. They arise from particular institutional responses to environmental and social pressures. Alternative arrangements concerning resource sharing, mobility, political participation and access to public services remain possible. The following scenario, *Negotiated Mobility*, examines a contrasting development in which states seek to manage these pressures through cooperation and recognised mobility rights.

6.3 Negotiated Mobility

Negotiated Mobility describes a future in which governments respond to changing settlement conditions through international cooperation, recognised mobility rights and shared institutional responsibilities.

Environmental pressures continue to affect the viability of settlements in the Hindu Kush Himalayan region. Water insecurity, changing agricultural conditions and exposure to natural hazards influence where people can maintain livelihoods. Some communities remain in their existing locations through adaptation and investment. Others increasingly rely on temporary migration, circular movement or permanent relocation.

Unlike *Fortress Earth*, governments do not respond primarily by restricting access to protected territories. They develop arrangements through which people can move between jurisdictions while retaining recognised rights and access to essential services. States remain sovereign. National borders, citizenship and immigration legislation continue to exist.

However, cooperation expands beyond the regulation of entry and residence. Governments negotiate responsibilities for employment, education, healthcare, social protection and the management of shared resources. Mobility becomes an accepted element of regional adaptation rather than an exceptional response to environmental emergencies.

The resulting system is neither without borders nor free from conflict. Its stability depends on the ability of institutions to maintain agreements despite competing national interests, unequal economic resources and changing population needs.

Environmental pressures and the need for cooperation

The environmental conditions examined in Chapters 2-4 provide the common starting point for all four TEOS 2100 scenarios. Changes in glacier and snow systems, river flows and mountain hazards may affect access to water, agricultural production and infrastructure.

These developments will differ between locations. Some settlements may remain viable through adaptation. Others may experience increasing costs, reduced economic opportunities or more frequent interruptions to essential services. The resulting population movements may occur within countries or across international borders.

For Negotiated Mobility, the central assumption is that governments recognise these developments as shared challenges. Environmental change in one jurisdiction can affect economic activity, infrastructure and population demand in another. Uncoordinated responses may therefore create additional costs for neighbouring states.

The International Organization for Migration's *World Migration Report 2026* emphasises that responses to climate-related mobility remain too frequently reactive and disconnected from long-term adaptation planning. It calls for stronger links between migration governance, climate policy, disaster risk reduction, development and social protection. The report also identifies local governments, communities and civil society as important participants in shaping effective responses.[185]

For TEOS 2100, these findings provide a basis for exploring cooperation that begins before environmental pressures produce large-scale displacement. Negotiated Mobility is therefore not limited to agreements for admitting people after disasters. It also involves anticipatory planning, investment and the coordination of responsibilities between regions.

Existing foundations of negotiated mobility

International cooperation on human mobility already takes several forms. States establish bilateral labour agreements, regional mobility arrangements and procedures for recognising qualifications. Some agreements facilitate temporary employment, while others provide residence rights extending over longer periods.

These instruments differ substantially in scope. The European Union provides a comparatively extensive framework for free movement among participating states. Other regional arrangements are more limited.

The Association of Southeast Asian Nations facilitates certain forms of temporary professional mobility through its Agreement on the Movement of Natural Persons and mutual recognition arrangements. These instruments support movement for specified economic activities. They do not establish an unrestricted right for all ASEAN citizens to live and work throughout the region.[186]

[185] Narusova-Schmidt, A., & Lincango, M. (2026). Addressing Climate Mobility: The Role of Local and Community Action. In M. McAuliffe & P. Ceriani Cernadas (Eds.), *World Migration Report 2026*, Chapter 6. Geneva: International Organization for Migration. https://publications.iom.int/books/world-migration-report-2026-chapter-6

[186] Association of Southeast Asian Nations (ASEAN). *Mobility of Businesses and People*. ASEAN Economic Community. Includes information on the Agreement on the Movement of Natural Persons and Mutual Recognition Arrangements. https://asean.org/our-communities/economic-community/mobility-of-businesses-and-people/

The distinction matters for TEOS 2100. Negotiated Mobility does not require every participating country to adopt the same legal model. Cooperation may develop through arrangements adapted to particular migration corridors and regional conditions.

An agreement concerning seasonal agricultural work could have different requirements from one providing long-term residence to households affected by environmental deterioration. A framework for recognising vocational qualifications would differ from an agreement concerning access to healthcare. The scenario explores how such arrangements could gradually become more coherent and extensive.

The Australia-Tuvalu Falepili Union

The Australia-Tuvalu Falepili Union provides an existing example of cooperation between states facing very different environmental and economic circumstances. The treaty was signed on 9 November 2023 and entered into force on 28 August 2024. It recognises Tuvalu's continuing statehood and sovereignty notwithstanding the effects of climate-related sea-level rise.

It also establishes commitments concerning climate adaptation, disaster assistance, security and human mobility. The Falepili Mobility Pathway allows eligible citizens of Tuvalu to apply for permanent residence in Australia. Visa holders can live, work and study in Australia while maintaining the possibility of movement between the two countries. The arrangement does not require individuals to abandon their Tuvaluan nationality or sever their relationships with their country of origin.

For the 2026-2027 programme year, Australia allocated up to 280 visa places, including eligible family members, through a selection procedure based on an electronic ballot.[187] This arrangement provides an institutional precedent for mobility accompanied by recognised residence rights.

However, it should not be treated as a general international climate migration system. Its eligibility requirements and scale reflect the circumstances of the two participating countries. The agreement also contains security obligations that have generated political and legal debate.

For Negotiated Mobility, the significance of the Falepili Union lies in demonstrating that states can negotiate mobility as part of a wider relationship involving adaptation and sovereignty. Its limitations are equally relevant. A cooperative system requires agreement not only about opportunities for movement but also about the obligations accepted by participating governments.

The role of the United Nations

[187] Australia and Tuvalu (2023). *Australia–Tuvalu Falepili Union Treaty*, signed 9 November 2023 and entered into force 28 August 2024. Australian Department of Foreign Affairs and Trade. https://www.dfat.gov.au/geo/tuvalu/australia-tuvalu-falepili-union-treaty. See also Australian Department of Home Affairs (2026). *Pacific Engagement Visa (Subclass 192), Treaty Stream (Tuvalu)*. https://immi.homeaffairs.gov.au/visas/getting-a-visa/visa-listing/pacific-engagement/subclass-192-treaty-stream

The United Nations already provides frameworks through which states cooperate on climate change, migration and the protection of displaced populations. The Paris Agreement was adopted under the United Nations Framework Convention on Climate Change in 2015. The accompanying Conference of the Parties decision established a Task Force on Displacement under the Warsaw International Mechanism for Loss and Damage. Its mandate concerns recommendations for integrated approaches to averting, minimising and addressing displacement related to the adverse effects of climate change.[188]

The *Global Compact for Safe, Orderly and Regular Migration*, adopted in 2018, provides a further framework for international cooperation. It encourages states to address adverse drivers of migration, improve regular pathways and strengthen coordination. The Compact is not legally binding and does not create an independent right to international admission.

These arrangements demonstrate that climate-related mobility has become an established subject of international policy. However, the United Nations cannot simply impose a comprehensive migration system on sovereign states. International organisations depend on the legal authority granted to them and on the commitments of participating governments.

Negotiated Mobility therefore does not assume the emergence of a global government responsible for allocating migrants between countries. Instead, the scenario envisages the United Nations as a forum for developing principles, supporting coordination and assisting states in implementing agreed arrangements. Its effectiveness would depend on the willingness of governments to translate cooperation into law and practice.

Why states might cooperate

International cooperation involves political choices. Governments may face pressures to protect domestic employment, maintain public services and respond to concerns about migration. They may also recognise economic and security benefits from coordinated arrangements.

Labour mobility can help address shortages in particular sectors. Cooperation on shared river systems may reduce uncertainty concerning infrastructure and water use. Agreements concerning disaster preparedness may improve the capacity of neighbouring states to respond to transboundary hazards.

Ian Hurd's analysis of legitimacy and authority in international politics distinguishes between coercion, self-interest and legitimacy as mechanisms influencing compliance with international rules. His argument challenges the assumption that international cooperation can be explained solely through material power or immediate national interest. Perceived legitimacy can influence whether states accept rules and institutional authority.[189]

[188] United Nations Framework Convention on Climate Change (UNFCCC) (2015). *Decision 1/CP.21: Adoption of the Paris Agreement*, paragraph 49, establishing the Task Force on Displacement. See also UNFCCC, *Task Force on Displacement*. https://unfccc.int/event/fourth-meeting-of-the-task-force-on-displacement-tfd4

[189] Hurd, I. (1999). Legitimacy and Authority in International Politics. *International Organization*, 53(2), 379–408. https://doi.org/10.1162/002081899550913

For Negotiated Mobility, the implication is that cooperation cannot depend exclusively on sanctions or external pressure. Agreements need to offer credible benefits and be regarded as legitimate by their participants. This is relevant to both international negotiations and the communities affected by their implementation.

A migration agreement may be formally accepted by governments while remaining politically contested in receiving municipalities. A water allocation arrangement may be legally binding but generate opposition among communities that perceive its effects as unfair. The durability of cooperation therefore depends on its institutional design and public acceptance.

2026-2040: From crisis response to anticipatory planning

During the first period, governments continue to respond to environmental change through existing national institutions. Disaster assistance, migration administration and infrastructure planning remain largely separated.

However, recurring environmental pressures create stronger reasons to coordinate. States may begin by improving information exchange, disaster preparedness and the administration of existing migration pathways. Regional consultations address the possibility of temporary residence and employment for people affected by environmental deterioration.

Governments may also examine how migration can support household adaptation before continued residence becomes unsafe. The Falepili Union provides an example of a bilateral arrangement already established by 2026. The *Global Compact for Migration* and the Task Force on Displacement provide broader policy frameworks.

Ama Francis (2019) examined how existing free-movement arrangements in the Caribbean might help respond to climate-induced migration. The study argues that regional mobility agreements could be used more effectively to support people affected by disasters and environmental change.[190] This research does not establish that such agreements can be transferred directly to the Hindu Kush Himalayan region. It demonstrates that the development of new protection mechanisms may build on existing regional institutions.

In Negotiated Mobility, governments increasingly treat such arrangements as potential components of adaptation policy. Cooperation remains uneven. Some states may support expanded mobility while others prioritise narrower labour agreements or temporary admission. The first period therefore involves experimentation and negotiation rather than the establishment of a comprehensive regional system.

2041-2060: Mobility rights become more predictable

In the second period, the scenario assumes that a growing number of participating states have established arrangements for regular movement. These may include seasonal employment, longer-term residence and procedures for families relocating from environmentally exposed regions.

[190] Francis, A. (2019). *Free-Movement Agreements & Climate-Induced Migration: A Caribbean Case Study*. Sabin Center for Climate Change Law, Columbia Law School. https://scholarship.law.columbia.edu/sabin_climate_change/62/

The agreements are not necessarily identical. Some may involve neighbouring countries. Others may connect regions through established labour markets extending beyond South Asia. Participating states clarify admission requirements, employment rights and procedures for renewing or changing residence status. Greater predictability can reduce the risks associated with irregular movement.

However, legal admission is only one component of secure mobility. People also require housing, employment opportunities and access to essential services. Receiving regions may face financial and administrative pressures when population growth increases demand.

For Negotiated Mobility, agreements therefore begin to address the distribution of responsibilities between national and local governments. Some arrangements may include financial contributions to infrastructure and public services. Others may coordinate information concerning available employment or the recognition of qualifications. The system remains dependent on political negotiation. Expansion is neither automatic nor uniform.

Social protection across jurisdictions

The portability of social protection becomes increasingly relevant where people work and reside in different countries. Pension contributions, healthcare entitlements and employment-related benefits are generally organised through national legislation. Workers who move may encounter gaps or lose recognition of previous contributions.

Holzmann and Wels (2020) examined the cross-border portability of social security benefits. Their study found that significant differences remain between migrants covered by comprehensive portability agreements and those whose benefits are only partially transferable or unavailable.[191]

The European Union provides an existing example of social security coordination. Its framework includes rules concerning applicable legislation, equal treatment, recognition of relevant insurance periods and the exportability of certain benefits. National systems remain distinct. Coordination does not require the creation of a single supranational welfare state.

For Negotiated Mobility, similar principles could inform agreements between participating jurisdictions. Workers might retain recognised insurance histories when moving between countries. Periods of employment could be aggregated where appropriate. Certain benefits might remain payable after a change of residence.

However, the details would depend on the agreements established. No general assumption can be made that all benefits would become transferable. Financing, eligibility and administrative responsibility would remain subjects of negotiation.

Education and healthcare under negotiated mobility

Educational continuity presents another institutional requirement. Children who move between regions may encounter different curricula, languages and enrolment procedures. The recognition of previous learning can determine whether a child continues education

[191] Holzmann, R., & Wels, J. (2020). The Cross-Border Portability of Social Security Benefits: Status and Progress? *International Social Security Review*, 73(1), 65–97. https://doi.org/10.1111/issr.12228

without unnecessary interruption. Chapter 5.2 examined existing mechanisms for educational portability and qualification recognition.

In Negotiated Mobility, participating governments could develop agreements concerning enrolment, the transfer of learning records and the recognition of completed instruction. These arrangements might reduce administrative barriers while preserving national responsibility for education.

Healthcare raises related questions. A person may require treatment while residing outside the country in which their insurance contributions were made. Electronic medical records can improve the availability of clinical information. However, access to healthcare depends on recognised entitlements and arrangements for financing treatment.

The European Health Data Space illustrates a developing approach to technical and legal coordination of health information. Its full implementation is being introduced in stages and should not be confused with an existing system of universal cross-border healthcare coverage. For Negotiated Mobility, technical interoperability would support cooperation, but rights and financing would remain central.

Economic activity across several locations

A negotiated mobility system could support households maintaining livelihoods in more than one location. A family might retain agricultural land in its region of origin while members obtain employment elsewhere. Income earned through migration could support housing, education or adaptation investments. People may also return periodically or establish permanent residence in another country while maintaining social and economic connections with their original community. These arrangements already exist in contemporary labour migration.

Negotiated Mobility explores their possible expansion under conditions of increasing environmental pressure. However, the benefits would remain uneven. Workers with recognised qualifications may have access to more favourable employment conditions. People with limited resources may struggle to finance movement or secure suitable accommodation. Receiving labour markets may also experience pressure in particular occupations.

Negotiated Mobility does not assume that migration automatically produces economic growth or equal opportunities. Its central proposition is that institutions can reduce some of the risks by providing more predictable legal status, employment protection and social security coordination.

Water governance as part of mobility cooperation

The management of population movement cannot be separated from the management of shared resources. The Hindu Kush Himalayan region contains river systems connecting several countries and extensive downstream populations. Water allocation affects agriculture, hydropower, industry and public services. Existing treaties demonstrate that cooperation is possible, but political disputes can complicate their implementation. The Indus Waters Treaty dispute of 2025-2026 illustrates these tensions.

In Negotiated Mobility, states seek to address such disputes through negotiated procedures, technical cooperation and institutions capable of managing disagreements. The scenario does not assume that historical conflicts disappear. Instead, it explores a situation in which participating governments continue to regard cooperation as preferable to unilateral action, even when disagreements occur. This could involve shared hydrological information, coordinated infrastructure planning and agreed procedures for addressing competing uses of water.

The development of such arrangements would depend on the characteristics of each river basin. The wider objective would be to reduce uncertainty and create conditions in which adaptation planning is not undermined by avoidable institutional conflict.

Community participation and the distribution of benefits

International agreements do not automatically provide fair outcomes for local populations. A hydropower project may benefit national energy systems while creating costs for communities affected by land acquisition or changing river flows. Infrastructure investment may improve conditions for some settlements while altering livelihoods elsewhere. Udisha Saklani (2026) examines these tensions in Nepal's Himalayan hydropower development.

Drawing on fieldwork and institutional analysis, the study shows that benefit-sharing arrangements, national development narratives and local experiences influence the legitimacy of energy projects. Community responses involve economic interests, social relationships and expectations concerning future opportunities.[192] The findings challenge the assumption that a technically or economically beneficial infrastructure project will automatically secure local support.

For Negotiated Mobility, this has implications beyond hydropower. Migration agreements and regional adaptation programmes may require similar attention to the distribution of costs and benefits. Receiving municipalities may need additional infrastructure. Communities of origin may experience labour shortages or changing family arrangements.

People affected by new resource-management systems may seek representation in decisions. The durability of cooperation therefore depends partly on whether institutions can respond to local concerns. Negotiated Mobility is not solely a system of agreements between national governments. It also requires coordination with regional authorities, municipalities and communities.

2061-2080: Cooperation under sustained pressure

During the third period, environmental pressures continue to affect settlement viability and resource availability. The scenario assumes that negotiated mobility arrangements have become established components of regional governance. However, their stability is repeatedly tested.

Receiving regions may experience housing shortages or increasing demand for public services. Political debates may emerge over the number of people admitted, eligibility

[192] Saklani, U. (2026). Beyond Binaries: Negotiating Resource Futures in the Himalayas. *Geoforum*, 170, Article 104556. https://doi.org/10.1016/j.geoforum.2026.104556

requirements and financial contributions between participating states. Environmental disasters may create needs that exceed existing admission and assistance arrangements. Some governments may seek to renegotiate their commitments. Others may argue that agreed responsibilities are being distributed unfairly.

Negotiated Mobility does not assume that cooperation prevents such disputes. Its defining feature is that governments maintain procedures through which disagreements can be addressed. Agreements may be revised, financial contributions adjusted or administrative responsibilities clarified. These processes can be politically difficult and time-consuming.

Nevertheless, the scenario assumes that institutions retain sufficient legitimacy for participants to continue negotiating rather than abandon cooperation entirely.

The limits of negotiated mobility

The existence of legal mobility pathways does not guarantee that everyone can use them. Agreements may have eligibility requirements, financial conditions and limits on the number of participants. Some workers may qualify for residence based on their occupation. Other individuals may lack the documents required to apply. A person may receive permission to work without obtaining access to the same social benefits as permanent residents.

Even comprehensive agreements can leave gaps concerning people outside their scope.

For Negotiated Mobility, these limitations remain important. The scenario should not be understood as a world in which all borders have disappeared or all migration has become voluntary. Environmental deterioration may still force people to leave locations they would otherwise prefer to remain in. Receiving communities may continue to experience tensions associated with population growth.

The effectiveness of negotiated arrangements depends on whether they create meaningful opportunities for people with different economic and social circumstances. A system that supports highly qualified workers while excluding lower-income populations may remain cooperative between states without providing equitable protection. This tension provides one of the principal risks within the scenario.

The role of digital infrastructure

Digital systems may help coordinate institutions across jurisdictions. Electronic identity records can support administrative recognition. Portable educational records may assist with enrolment. Electronic health information can improve continuity of treatment. Information systems may help authorities identify demand for housing, employment and public services.

However, such technologies do not themselves create rights. Access to residence, employment and social protection remains governed by law. Chapter 5.6 also identified risks involving privacy, exclusion and infrastructure dependence.

In Negotiated Mobility, digital systems are intended to support recognised entitlements rather than determine access through proprietary platforms. The scenario assumes that participating governments develop common technical standards and procedures for exchanging essential information.

Nevertheless, differences between national systems would persist. The costs of implementation, protection of personal information and accessibility for people without digital equipment would remain important. Technology can reduce administrative friction, but it cannot replace negotiation over legal responsibilities.

2081-2100: Mobility becomes an established institution

By the final period, the scenario has developed into an international and regional system in which negotiated mobility is a recognised component of social and economic organisation. People continue to live in permanent settlements. Cities, villages and productive regions remain important centres of employment and public services. However, residence in a single location is no longer the sole basis through which individuals maintain access to some essential rights.

Participating states have developed arrangements for recognising employment histories, qualifications and certain social entitlements across jurisdictions. Households may maintain economic and family relationships in several countries. Some people move temporarily. Others relocate permanently or return periodically to their places of origin. These patterns coexist with populations that remain in established settlements.

The international system continues to be organised around sovereign states. National citizenship retains legal and political significance. However, regional agreements reduce some of the disadvantages associated with movement across borders.

The resulting framework is not uniform across the world. Some regions possess extensive mobility arrangements, while others maintain more restrictive policies. Differences in economic resources and institutional capacity continue to influence access.

Negotiated Mobility therefore describes a comparatively cooperative future rather than one in which environmental pressures and social inequalities have disappeared.

Governance and democratic legitimacy

International agreements require institutions capable of implementation. National authorities may remain responsible for citizenship, immigration legislation and social protection. Regional bodies may coordinate mobility agreements and shared infrastructure. Local governments may provide education, healthcare, housing and other services to populations changing in size or composition.

These responsibilities can create questions concerning democratic participation. A person may reside in one jurisdiction while retaining political rights in another. Temporary residents may contribute economically without possessing the same voting rights as citizens or permanent residents. Chapter 5.1 examined the possibilities and limitations of extraterritorial citizenship. Collyer (2014) demonstrates that political participation by citizens living abroad already exists in different national systems.[193]

[193] Collyer, M. (2014). A Geography of Extra-Territorial Citizenship: Explanations of External Voting. *Migration Studies*, 2(1), 55–72. https://doi.org/10.1093/migration/mns008

For Negotiated Mobility, the challenge is to maintain political representation while recognising that individuals may participate in the social and economic life of several jurisdictions. Possible responses include consultation mechanisms for temporary residents, greater participation in local planning and continued recognition of political rights connected to nationality. However, the scenario does not assume that citizenship becomes fully portable or that political rights become identical across countries. The legitimacy of its institutions depends partly on how they manage these differences.

Financing shared responsibilities

A coordinated mobility system requires financial arrangements. Receiving municipalities may need additional housing, transport capacity and public services. Education and healthcare institutions may need to accommodate new residents. Governments may face questions concerning the allocation of costs for social protection and infrastructure. Regions losing population may also experience fiscal pressures. They may retain responsibility for infrastructure while receiving less revenue.

For Negotiated Mobility, participating states develop arrangements for distributing some of these costs. Such mechanisms could include national transfers to receiving municipalities, bilateral financing agreements and regional infrastructure programmes. The design would depend on existing tax systems and political agreements. A regional institution might coordinate investment without replacing national budget authority. Social security agreements might determine which country is responsible for particular benefits.

These mechanisms would require transparent procedures and reliable information. They could also become subjects of political disagreement. The scenario assumes that institutions retain the capacity to negotiate changing responsibilities, not that financing disputes disappear.

Social cohesion within a cooperative mobility system

Legal rights alone do not ensure social cohesion. People may obtain residence permission while encountering social exclusion or difficulty establishing relationships in a receiving community. Language differences, housing shortages and unequal economic opportunities may create tensions. Chapter 5.4 examined research showing that displacement does not inevitably weaken social cohesion. The outcomes depend on public services, institutional trust and opportunities for participation.

For Negotiated Mobility, social inclusion remains a continuing task. Receiving communities may need opportunities to participate in decisions concerning infrastructure and resource allocation. Newcomers may require access to education, employment and local organisations. Community-based institutions can help address disagreements, but they cannot compensate indefinitely for inadequate public investment.

The scenario therefore assumes that cooperation extends beyond formal admission agreements. Its institutions seek to maintain conditions under which established residents and newcomers can participate in shared social and economic life. However, cultural identities and national affiliations remain diverse.

Negotiated Mobility does not require people to abandon their relationships with their places of origin.

Human Implications

In Negotiated Mobility, a household facing declining agricultural income may have access to recognised employment opportunities in another region. One family member might work abroad while others remain in the community of origin. An agreement between participating states could protect the worker's legal residence, establish labour rights and allow certain social insurance periods to be recognised. Children moving with their families might enter schools through coordinated enrolment procedures rather than starting their education again.

However, these arrangements would not remove all difficulties. Housing may be expensive in receiving regions. Employers may offer insecure work. Families may experience prolonged separation. Public authorities must balance their responsibilities to established residents and incoming populations.

The two fictional perspectives developed in Chapter 7 examine these tensions through a family maintaining relationships across jurisdictions and a local official responsible for implementing agreed mobility arrangements. Their experiences show that cooperation can expand individual choices while creating continuing responsibilities for the institutions involved.

Implications for TEOS 2100

Negotiated Mobility represents a possible response to the environmental and social pressures examined in this report. Its central assumption is that states increasingly recognise mobility as a shared institutional responsibility. Rather than treating population movement primarily as a security problem, governments develop agreements concerning residence, employment, public services and resource management.

Existing arrangements provide starting points. The Australia–Tuvalu Falepili Union demonstrates how permanent residence rights can be negotiated while preserving connections to the country of origin. European social security coordination provides an example of recognising certain entitlements across national systems. Regional mobility agreements and international frameworks concerning displacement demonstrate additional mechanisms through which cooperation can develop.

These examples do not establish that a comprehensive mobility system will emerge by 2100. They show that some of its possible components already exist. For TEOS 2100, the important distinction concerns the relationship between mobility and rights. A person may possess the physical ability to move without having secure access to employment, housing or essential services.

Negotiated Mobility explores whether agreements between institutions could reduce these gaps. The scenario does not eliminate environmental pressures, resource competition or political disagreement. Its central proposition is that cooperation can provide more predictable ways of addressing these conditions.

The ultimate measure of its effectiveness is not the number of agreements concluded or the volume of migration they facilitate. It is whether people can remain in viable settlements, move when necessary and maintain secure livelihoods and recognised rights across changing locations. The following scenario, *Networked Nomads*, examines a different development in which mobility becomes extensive but institutional protection remains more fragmented.

6.4 Networked Nomads

Networked Nomads describes a future in which economic activity, public services and social relationships increasingly operate through transnational digital networks, while legal protection and political participation remain fragmented.

Environmental change continues to influence the viability of settlements in the Hindu Kush Himalayan region. Some households maintain their livelihoods through adaptation, while others depend more heavily on temporary employment, circular migration and economic relationships extending across several countries.

Digital infrastructure enables new forms of coordination. Workers can obtain assignments from employers or clients in distant locations. Educational records and selected services can remain accessible when people move. Financial systems support transactions between households, businesses and institutions operating across borders. However, the development of these networks is not matched by equally extensive agreements concerning residence, employment rights and social protection.

Governments retain control over citizenship, immigration and public benefits. Private organisations and digital platforms increasingly influence access to employment and essential services. Some individuals gain substantial flexibility. Others become dependent on systems they cannot effectively influence or challenge.

The defining feature of Networked Nomads is therefore not mobility itself. It is the growing difference between the geographical reach of economic networks and the territorial limits of legal and political protection.

Environmental pressures and the diversification of livelihoods

The environmental conditions examined in the preceding chapters provide the starting point for this scenario. Changing water availability, pressure on agricultural production and recurring natural hazards may affect settlement viability in different parts of the Hindu Kush Himalayan region.

The consequences will vary between locations and households. Some communities may continue existing livelihoods through adaptation and investment. Others may experience declining agricultural income, reduced employment opportunities or increasing uncertainty about infrastructure and essential services. Under these conditions, households may seek additional sources of income elsewhere. Chapter 5.3 examined how labour migration and remittances can support the diversification of livelihoods.

Networked Nomads explores a future in which this geographical diversification becomes closely connected to digital coordination. A household may continue agricultural production

in one region while a family member undertakes temporary work elsewhere. Another may depend on remote employment without relocating permanently. Some workers may move repeatedly between locations according to demand generated through digital labour markets.

However, these forms of mobility remain subject to legal, economic and physical constraints. The availability of digital employment does not establish an unrestricted right to enter another country or reside where work is offered.

Demographic change and regional labour markets

Demographic developments provide one possible source of demand for international labour. The United Nations *World Population Prospects 2024* projects substantial population decline in China, Japan and the Republic of Korea during the twenty-first century. Under the UN's medium projection, China's population is expected to decline by more than half between the early 2020s and 2100. The projections also indicate continuing population ageing and decline in Japan and the Republic of Korea.[194]

These figures are conditional projections based on demographic assumptions. They should not be interpreted as precise predictions of population size or future labour demand. Technological change, labour-force participation, economic development and migration policies could substantially alter the consequences of demographic ageing. Nevertheless, the projections provide a relevant starting point for considering how Asian labour markets might develop.

Japan already employs substantial numbers of foreign workers. According to its Ministry of Health, Labour and Welfare, the number of foreign workers reached approximately 2.57 million in October 2025. The ministry reported that addressing labour shortages was the most frequently cited reason among surveyed employers for hiring foreign workers.[195] These developments do not establish that Japan, China or South Korea will adopt a common labour-migration policy.

For Networked Nomads, they provide a basis for exploring a future in which demand for workers and changing environmental conditions contribute to more extensive cross-border economic relationships.

From labour migration to network-based employment

Conventional labour migration often involves movement towards an employer or established workplace. Digital technologies can modify this relationship. Online platforms may connect workers and clients without requiring them to live in the same country. Other platforms organise physical work by matching workers with tasks in particular locations.

[194] United Nations Department of Economic and Social Affairs (UN DESA) (2024). *World Population Prospects 2024: Summary of Results*. New York: United Nations. https://population.un.org/wpp/
[195] Ministry of Health, Labour and Welfare, Japan (2026). *Summary of Notifications on the Employment of Foreign Nationals, as of the End of October 2025*. Tokyo. https://www.mhlw.go.jp/stf/newpage_68794.html

The International Labour Organization distinguishes between online web-based platforms and location-based digital labour platforms. Its *World Employment and Social Outlook 2021* documents how platform systems influence work allocation, remuneration, supervision and employment conditions.[196]

These systems can expand access to economic opportunities. They may also shift business risks and costs towards workers. Automated systems can determine which assignments are visible, how workers are evaluated and whether accounts remain active.

For Networked Nomads, the significance lies in the possible expansion of these arrangements across increasingly mobile populations. Employment may become less dependent on permanent residence near one employer. However, access to work may become more dependent on digital platforms, professional networks and commercial rules. The capacity to earn an income does not necessarily provide secure employment or recognised social rights.

Private coordination and fragmented governance

In Negotiated Mobility, states develop agreements that connect movement with recognised rights and responsibilities. Networked Nomads follows a different institutional pathway. Economic networks become increasingly international, but governments do not establish equivalent systems of social protection or political participation. Private platforms may provide access to employment, accommodation, financial services and information.

Some organisations may coordinate several functions through connected digital accounts. Workers may depend on these systems to identify available jobs, demonstrate qualifications or maintain records of previous assignments. This does not mean that private companies replace states. National authorities continue to regulate residence, employment and access to public services.

However, responsibility for individual outcomes becomes divided between institutions operating under different legal frameworks. A worker may receive assignments through an international platform, perform work in one country and retain legal residence in another. If a dispute arises, the worker may encounter uncertainty concerning the applicable rules or the authority responsible for enforcement.

This fragmentation is the central governance problem of Networked Nomads.

The emergence of private rules for access

Digital platforms do more than transmit information. They can establish the conditions under which individuals participate in economic relationships. A platform may determine how workers demonstrate qualifications, how clients evaluate performance and which participants remain eligible for assignments.

[196] International Labour Organization (ILO) (2021). *World Employment and Social Outlook 2021: The Role of Digital Labour Platforms in Transforming the World of Work*. Geneva: ILO. https://www.ilo.org/publications/summary-role-digital-labour-platforms-transforming-world-work

Its commercial terms may affect income and access to future work. The ILO's analysis of digital labour platforms identifies algorithmic management as a significant feature of contemporary platform work. Automated systems can influence task allocation, remuneration and performance assessment. Workers may face difficulties understanding or challenging decisions made through these systems.

In September 2026, the United Nations Department of Economic and Social Affairs published a policy brief on decent work in digitally managed labour markets. It highlighted the opportunities created by platform-mediated work alongside risks involving insecure employment relationships, limited collective bargaining and inadequate social protection. The brief also examined the influence of automated management on workers' opportunities and conditions.[197]

These findings provide an empirical starting point for Networked Nomads. The scenario explores what could happen if the economic importance of such systems expands without corresponding improvements in public regulation and access to remedies.

2026-2040: Digital employment expands unevenly

During the first period, digital employment and cross-border service provision continue to develop. Remote work remains concentrated in occupations that can be performed through communication technologies. Location-based platforms organise transport, delivery and other services in growing urban markets.

The opportunities remain uneven. Workers with recognised qualifications, reliable connectivity and appropriate equipment can participate more easily. Others encounter barriers related to education, language, documentation or the cost of digital access. The International Telecommunication Union's 2026 *Facts and Figures* report documents continuing differences in connectivity, quality, affordability and digital skills. These inequalities affect who can participate in increasingly digital economies.[198]

In the Hindu Kush Himalayan region, environmental pressures may contribute to the need for additional income sources. Digital employment becomes one option among several. It does not replace agriculture, manufacturing or other location-dependent activities. Some households use remote work or digital labour platforms to diversify income. Others remain dependent on seasonal labour migration and physical employment opportunities.

The first period establishes the possibility of network-based livelihoods without producing an integrated system of rights.

[197] Perry, J., & Hu, W. (2026). *Decent Work in the Platform Economy: Governing Digitally Managed Labour Markets*. UN DESA Policy Brief No. 194, 10 September 2026. New York: United Nations. https://desapublications.un.org/policy-briefs/un-desa-policy-brief-no-194-decent-work-platform-economy-governing-digitally-managed

[198] International Telecommunication Union (ITU) (2026). *Facts and Figures 2026*. Geneva: ITU. https://www.itu.int/en/mediacentre/Pages/PR-2026-11-03-Facts-and-Figures.aspx

China, Japan and South Korea as possible economic centres

The student scenario identified China, Japan and South Korea as important potential destinations and economic partners for mobile populations. This geographical focus is retained, but the relationships between these countries require differentiation. Their demographic trajectories, economic structures and migration policies are not identical.

China has a large domestic market, substantial manufacturing capacity and extensive digital infrastructure. Japan and South Korea possess advanced industrial and service economies and face significant demographic ageing. However, these conditions do not determine their future immigration or labour policies.

A 2025 analysis by Impiombato and Grünberg examines China's demographic decline and policy efforts to address low fertility. The authors identify the economic and political significance of demographic change while emphasising the limitations of policies intended to reverse declining birth rates.[199]

For Networked Nomads, the relevant uncertainty is how governments might respond to future labour demand. They could expand opportunities for permanent immigration. They could rely more heavily on temporary workers. They might also increase automation or reorganise production to reduce labour requirements.

The scenario explores one possible combination: economic openness to internationally networked labour alongside continuing restrictions on permanent membership and social rights. This should not be interpreted as a prediction of policies pursued by any particular country.

Political identity and the limits of economic inclusion

Economic participation does not necessarily produce political membership. A worker may contribute to a country's economy without obtaining citizenship or long-term residence. Temporary employment arrangements can provide income while limiting access to public services, family reunification or political participation. These differences already exist in contemporary migration systems.

They may become more consequential if employment relationships extend increasingly across borders. China's *Ethnic Unity and Progress Promotion Law*, adopted on 12 March 2026 and effective from 1 July 2026, provides an example of the continuing political importance of national identity. Chinese authorities describe the legislation as promoting ethnic unity, social cohesion and common development. Human rights organisations and UN experts have raised concerns that some provisions could restrict cultural, linguistic or religious rights.[200]

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[199] Impiombato, D., & Grünberg, N. (2025). *When Giving Birth Is a National Duty: Beijing's Struggle to Reverse Demographic Decline*. China Horizons Policy Brief. Berlin: Mercator Institute for China Studies. https://merics.org/sites/default/files/2025-10/251008%20Policy%20Brief%20Family%20Planning_0.pdf

[200] Law of the People's Republic of China on Promoting Ethnic Unity and Progress, adopted 12 March 2026, effective 1 July 2026. Legislative text and documentation available through NPC Observer. https://npcobserver.com/legislation/law-on-promoting-ethnic-unity-and-progress/

These positions concern the interpretation and possible effects of the legislation. They do not demonstrate that China will reject immigration or adopt a particular labour policy in 2100. For TEOS 2100, the broader analytical question is how economic integration interacts with citizenship and political rights.

Networked Nomads examines a future in which economic networks become more international while political membership remains primarily territorial.

2041-2060: Employment mobility becomes more network-dependent

During the second period, the scenario assumes that digital employment systems have become more influential in connecting workers with opportunities across Asia. Labour demand remains uneven between sectors and regions. Some occupations require physical relocation. Others allow work to be performed remotely from another jurisdiction.

Workers may combine these arrangements over time. A person might undertake a temporary contract in one country, return to a family household elsewhere and later accept remote assignments for an employer operating in a third country. Digital platforms support these relationships by maintaining records of skills, previous assignments and professional evaluations.

However, access depends partly on the systems through which employment is organised. Workers may face costs associated with recruitment, digital services, housing and travel. Some may develop stable careers through recurring assignments. Others experience fragmented employment histories, variable income and limited opportunities for professional development. The scenario does not assume that all labour becomes digital. It examines the increasing importance of digital coordination in both remote and location-dependent employment.

Energy and infrastructure for mobile livelihoods

Digital economic participation requires physical infrastructure. Devices must be charged, communication networks maintained and payments processed. Mobile households may require access to electricity outside conventional permanent housing. Portable energy storage, distributed solar generation and shared charging facilities could support some of these needs.

However, their development depends on materials, production systems, costs and infrastructure. The International Energy Agency's *Global Critical Minerals Outlook 2025* identifies substantial concentration in the processing of minerals used in batteries and other

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See also United Nations Human Rights Special Procedures (2026). Communication OL CHN 5/2026 concerning the Law on Promoting Ethnic Unity and Progress, 16 April 2026. https://spcommreports.ohchr.org/TMResultsBase/DownLoadPublicCommunicationFile?gId=30922
For a civil society
, see Joint Statement by Hong Kong Diaspora (2026). *Joint Statement by Hong Kong Diaspora Condemning Beijing's Ethnic Unity Law and Its Assault on Communities in China and Beyond*, 13 July 2026. Published by Freedom House. https://freedomhouse.org/article/joint-statement-hong-kong-diaspora-condemning-beijings-ethnic-unity-law-and-its-assault

technologies. It documents China's major role in refining and battery-related supply chains. The report also examines the vulnerability of concentrated supply chains to disruptions.[201]

For Networked Nomads, these dependencies are relevant because digital economic participation can be interrupted by failures affecting electricity or communication. A worker may possess recognised qualifications and access to an international employment platform while lacking reliable power to use the system. More mobile livelihoods do not eliminate dependence on geographically concentrated production and infrastructure. They may create additional forms of interdependence.

Critical minerals and technological dependence

The concentration of critical mineral processing creates potential risks for countries and industries dependent on imported components. Battery production and digital infrastructure require materials obtained through international supply chains. These supply chains may be disrupted by trade restrictions, natural hazards or changes in industrial policy.

The IEA's 2025 assessment emphasises that concentration can increase vulnerability even when global production is sufficient to meet expected demand. However, current market structures do not establish which countries or companies will dominate particular technologies in 2100. Recycling, substitution, technological change and new investment may alter these relationships.

For Networked Nomads, the scenario assumes that dependence on complex supply chains remains relevant. It does not require China to retain its current market position unchanged. The institutional problem is broader. Where mobile livelihoods depend heavily on digital infrastructure, disruptions to the supply of energy or essential components can have consequences extending far beyond the location of the original disruption.

A failure in one part of the economic network may affect workers and households across several countries.

The consequences of platform dependence

A digitally mediated economy can offer flexibility while creating new forms of dependence. Workers may obtain assignments from different locations. However, they may also rely on individual platforms for access to clients, payments and professional reputations. A platform account can become economically valuable because it contains records of completed work and client evaluations. Losing access may therefore affect future income.

The ILO's research documents problems associated with account suspension, limited transparency and the dependence of some workers on platform ratings. The UN DESA policy brief of September 2026 identifies similar concerns.[202]

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[201] International Energy Agency (IEA) (2025). *Global Critical Minerals Outlook 2025*. Paris: IEA. https://www.iea.org/reports/global-critical-minerals-outlook-2025

[202] International Labour Organization (ILO) (2021). *World Employment and Social Outlook 2021: The Role of Digital Labour Platforms in Transforming the World of Work*. Geneva: ILO. See also Perry & Hu (2026)

Networked Nomads extends these observed difficulties into a hypothetical future. A worker may maintain professional relationships across several countries but have limited ability to challenge decisions by a platform operating elsewhere. Even where national labour legislation provides protection, cross-border enforcement may be difficult. This creates a distinction between the appearance of economic independence and the actual ability to influence working conditions.

2061-2080: Economic participation without equal social protection

During the third period, network-based employment and multi-local livelihoods have become established features of the scenario. Some workers possess extensive professional networks and can obtain assignments across several jurisdictions. Others depend on temporary contracts and fragmented employment histories. Governments maintain national systems for taxation, residence and social protection.

However, cross-border coordination remains incomplete. A worker may contribute economically in several locations without qualifying for continuous protection against illness, unemployment or old age. The ILO's *World Social Protection Report 2024–26* found that 52.4 per cent of the world's population was covered by at least one social protection benefit. It also identified large differences between countries and persistent gaps for people in non-standard or informal employment.[203]

These findings describe current conditions rather than a future trend extending automatically to 2100. For Networked Nomads, they provide a starting point for considering the consequences of employment arrangements that do not fit conventional national insurance systems. Without effective coordination, greater labour mobility may produce more fragmented protection. The possibility of working across borders would therefore coexist with significant insecurity.

Housing and temporary residence

Mobile employment requires access to accommodation. Workers undertaking temporary assignments may rely on short-term rental arrangements, employer-provided housing or shared accommodation. These arrangements can offer flexibility.

However, they may also expose workers to high costs and insecure tenure. In receiving regions with limited housing supply, demand from temporary and permanent residents can increase competition. The consequences depend on local planning, housing markets and public investment. Chapter 5.3 examined how changing property values may influence inequalities between locations.

In Networked Nomads, housing becomes part of a wider system of temporary access. Some workers may maintain several places of residence. Others may lack secure accommodation in any location. Digital platforms could facilitate the search for housing but would not guarantee affordability or adequate standards. For TEOS 2100, the important issue is

[203] International Labour Organization (ILO) (2024). *World Social Protection Report 2024–26: Universal Social Protection for Climate Action and a Just Transition*. Geneva: ILO. https://webapps.ilo.org/static/english/reports/flagship/world_social_protection_report_2024-26/Executive%20Summary.html

whether flexible access can coexist with security of tenure. A person may be economically mobile while remaining vulnerable to sudden loss of housing.

Education and the recognition of skills

Education and vocational qualifications influence participation in network-based labour markets. Workers with recognised skills may gain access to employment opportunities beyond their country of residence. However, qualifications obtained in one jurisdiction may not automatically be recognised elsewhere. Digital records can support verification, but legal and professional recognition remains dependent on institutions.

Chapter 5.2 examined UNESCO's existing frameworks for the recognition of qualifications and the continuity of education during displacement. In Networked Nomads, digital learning systems may expand, and private training providers may offer courses aligned with platform requirements. Some workers could use these opportunities to acquire new skills. Others may face difficulties because of language, cost or limited access to reliable instruction.

A further problem concerns the relationship between platform-specific credentials and publicly recognised qualifications. A worker may possess a favourable rating within one commercial system without obtaining a qualification recognised by employers or authorities elsewhere. For TEOS 2100, this illustrates the difference between market access and educational rights.

Healthcare and administrative fragmentation

Healthcare presents related difficulties. A mobile worker may require treatment in a country where they are temporarily employed. Digital medical records can improve continuity of information. However, access to treatment depends on the rules governing healthcare provision and insurance. A person may possess complete medical records without being entitled to publicly funded care. Others may be eligible for certain services but experience difficulties demonstrating that entitlement.

In Networked Nomads, the development of digital healthcare systems is not matched by comprehensive agreements concerning coverage. Some individuals may purchase private insurance suited to their travel and employment patterns. Others may depend on limited public services or arrangements connected to individual employers. The resulting inequalities affect the practical ability to maintain a mobile livelihood. The scenario demonstrates that digital access to information is not equivalent to access to public services.

Social relationships across networks

Networked livelihoods may support social relationships extending across several locations. Families can maintain communication despite geographical separation. Professional communities may develop through shared work and digital interaction. Cultural associations can connect members living in different countries. These relationships demonstrate that social cohesion is not necessarily dependent on permanent residence.

Chapter 5.4 examined existing forms of community organisation among mobile populations. However, network-based relationships can also be unstable. Temporary employment may

limit opportunities for sustained participation in local institutions. Workers may maintain contact with several communities while lacking secure membership in any one of them.

A person can therefore be economically connected and socially isolated at the same time. This is not an inevitable result of mobility. It depends on the availability of community institutions, the security of residence and the ability to participate in local social life. For Networked Nomads, the central question is whether transnational networks can support meaningful relationships when political and administrative membership remains limited.

Governance through platforms and public institutions

The growing influence of digital platforms creates questions about institutional authority. Private organisations may establish conditions for access to work and services. National governments continue to regulate citizenship, employment and public benefits. The interaction between these systems can produce gaps in accountability.

For example, a worker may challenge an employment-related decision under national law while the platform responsible for allocating assignments operates in another jurisdiction. Commercial dispute procedures may not provide the same protections as public legal systems.

The UN DESA policy brief of September 2026 identifies regulatory approaches concerning labour rights, algorithmic transparency and social protection in digitally managed labour markets. It emphasises the need for public governance even where work is organised through private systems.[204]

Networked Nomads explores what happens when these protections develop more slowly than digital economic integration. The scenario does not assume that all regulation disappears. Some jurisdictions may adopt effective labour standards and consumer protections. Others may provide weaker safeguards. The resulting landscape is fragmented rather than uniformly unregulated.

2081-2100: A connected but unequal mobile society

By the final period, network-based economic participation has become an established feature of social organisation. Digital platforms and transnational professional networks connect workers, employers and service providers across considerable distances. Some individuals maintain income and social relationships in several jurisdictions. Temporary residence and circular movement are familiar elements of economic life.

Permanent settlements remain essential. Cities, industrial centres, agricultural regions and infrastructure networks continue to provide the physical foundations of economic activity. However, the relationship between employment and residence has become more flexible for some groups. Legal protection has not developed at the same pace.

[204] Perry, J., & Hu, W. (2026). *Decent Work in the Platform Economy: Governing Digitally Managed Labour Markets*. UN DESA Policy Brief No. 194. United Nations Department of Economic and Social Affairs. https://desapublications.un.org/policy-briefs/un-desa-policy-brief-no-194-decent-work-platform-economy-governing-digitally-managed

Citizenship and long-term residence remain important determinants of access to public services. Some workers possess secure status and can use network-based employment to expand their opportunities. Others move repeatedly between temporary arrangements without obtaining stable protection or political participation.

This produces a society that is highly connected but unevenly inclusive. The defining inequality is not simply between mobile and settled people. It is between those who can use mobility as an opportunity and those whose mobility is shaped by economic necessity and limited rights.

Regional and international institutions

International organisations remain active in Networked Nomads. They may support cooperation on migration, digital standards and labour protection. Regional institutions may facilitate cross-border economic transactions and the exchange of administrative information. However, the scenario assumes that these arrangements do not develop into a comprehensive framework for protecting mobile populations.

One existing institutional example is the United Nations Framework Agreement on Facilitation of Cross-border Paperless Trade in Asia and the Pacific. The agreement entered into force in 2021 and promotes cooperation concerning electronic trade documents and related systems. It demonstrates that technical and administrative cooperation can develop across jurisdictions.[205]

However, agreements concerning digital trade do not automatically establish residence rights, social insurance or political representation for mobile workers. For TEOS 2100, the distinction between the mobility of economic transactions and the mobility of human rights is central. An international economy can become increasingly integrated while the protections available to individuals remain dependent on national institutions.

The limits of market-based coordination

Networked Nomads may provide considerable economic flexibility. However, market coordination does not necessarily address the distribution of essential resources or the protection of people unable to participate in paid employment. Children, older people and individuals requiring long-term care may depend on institutions beyond commercial networks. Workers who become ill or unemployed may lose the income required to obtain housing and services.

Environmental disasters can interrupt digital infrastructure and employment simultaneously. Private providers may withdraw from locations where maintaining services becomes unprofitable. For these reasons, a highly networked economy cannot be assumed to provide the institutional foundations of a viable society.

Public responsibilities remain necessary. The relevant question is whether governments and other institutions develop sufficient mechanisms for addressing the gaps created by

[205] United Nations Economic and Social Commission for Asia and the Pacific (ESCAP). *Framework Agreement on Facilitation of Cross-border Paperless Trade in Asia and the Pacific*. Entered into force in 2021. https://www.unescap.org/projects/cpta

fragmented economic arrangements. Networked Nomads examines a future in which these mechanisms remain incomplete.

Human Implications

In Networked Nomads, people may maintain economic relationships across several countries without possessing secure residence or social protection in all the locations where they work.

A skilled technician might receive assignments through international networks, travel between industrial centres and support relatives living in an environmentally exposed region. His income depends on access to digital platforms, reliable electricity and the continued availability of specialised equipment. A temporary worker undertaking less highly paid assignments may depend on similar systems while possessing fewer financial reserves and weaker legal protection.

For both individuals, an interruption to a platform or communication network can affect employment. However, their ability to respond differs. One may possess alternative clients, savings and secure accommodation. The other may lose access to work and housing within a short period.

Chapter 7 examines these conditions through the experiences of two people whose livelihoods are connected to the same international economic networks but whose rights and opportunities differ substantially. Their decisions illustrate how technological flexibility can coexist with economic and political insecurity.

Implications for TEOS 2100

Networked Nomads represents a possible future in which mobility and digital economic integration develop more rapidly than the institutional protection of mobile populations. Its starting conditions include demographic change, existing labour migration, the expansion of digital platforms and persistent differences in social protection.

These developments do not determine the future policies of China, Japan, South Korea or other countries. They provide a basis for exploring a particular configuration of economic and institutional change. In this scenario, individuals may participate in several labour markets and maintain relationships across borders.

However, access to employment increasingly depends on digital systems whose rules may be difficult to challenge. Social protection, residence and political participation remain tied to fragmented national arrangements. Some workers gain opportunities that would have been unavailable in a more geographically restricted economy. Others face insecure employment, unstable housing and limited access to public services.

Environmental pressures may increase the need for diversified livelihoods, but the capacity to benefit from network-based mobility remains unequal. For TEOS 2100, this scenario demonstrates that economic connectivity and freedom of movement are insufficient indicators of human security. A society may possess advanced digital infrastructure and extensive labour networks while leaving substantial parts of its population without reliable protection.

The relevant question is whether individuals can maintain secure livelihoods, obtain essential services and participate in decisions affecting their lives. Networked Nomads explores the consequences of a future in which economic integration does not produce equivalent institutional inclusion.

The following scenario, *Planetary Transition*, examines a contrasting development in which coordinated governance and sustained adaptation are directed towards maintaining viable living conditions in existing and changing settlements.

6.5 Planetary Transition

Planetary Transition describes a future in which governments, communities and economic institutions respond to environmental change through coordinated adaptation, ecological restoration and long-term investment in viable settlements.

The environmental pressures examined in Chapters 2-4 continue to affect the Hindu Kush Himalayan region. Changes in snow and glacier systems, water availability, agricultural conditions and mountain hazards create risks for communities and infrastructure. Some settlements become increasingly difficult to maintain. Others remain viable but require substantial changes in resource management, economic activity and public services.

Unlike *Fortress Earth*, governments do not concentrate protection primarily in selected territories while excluding less privileged populations. Unlike *Negotiated Mobility*, the principal response is not an expanding system of agreements for relocating people between jurisdictions. Instead, institutions place greater emphasis on maintaining and improving living conditions where adaptation remains feasible.

Mobility continues to play a role. Individuals and households can move temporarily or permanently when circumstances require it. However, relocation is not treated as the inevitable outcome of environmental deterioration.

The central proposition of Planetary Transition is that cooperative governance, ecological management and social investment could preserve a wider range of viable living conditions than would otherwise exist. This does not imply that all environmental losses can be prevented. The scenario explores how societies might respond to the limits of adaptation without abandoning the objective of securing viable places for people to live.

Climate-resilient development as an institutional approach

The relationship between environmental change and settlement viability cannot be understood through physical exposure alone. A settlement may face water scarcity, changing agricultural conditions or recurring natural hazards while retaining the institutional and economic capacity to adapt. Another location exposed to similar conditions may experience declining viability because infrastructure, public services or financial resources are inadequate.

The IPCC's Sixth Assessment Report identifies climate-resilient development as an approach that integrates climate adaptation, mitigation and sustainable development. It emphasises the importance of coordinated action across sectors and levels of governance.

The assessment also finds that integrated and inclusive approaches can improve the effectiveness of adaptation and reduce the risk of unintended consequences.[206]

For Planetary Transition, these findings provide the principal conceptual foundation. The scenario assumes that climate-resilient development becomes increasingly influential in public investment, resource governance and economic planning. Rather than treating environmental protection, economic development and social inclusion as separate objectives, institutions seek to address their interactions.

This does not eliminate conflicts between competing objectives. Investment in renewable energy may create demand for land and materials. Water infrastructure may benefit some users while affecting others. Ecological restoration may require changes in established agricultural practices.

The defining feature of the scenario is that these trade-offs become explicit subjects of governance rather than being left primarily to individual economic or political actors.

Environmental limits remain

Planetary Transition should not be interpreted as a future in which technological or institutional progress restores all environmental conditions to their previous state. The Hindu Kush Himalayan cryosphere is undergoing changes that are already substantial.

The ICIMOD report *Water, Ice, Society, and Ecosystems in the Hindu Kush Himalaya* documents accelerating glacier loss, changes in snow cover and the consequences for ecosystems and human communities. It identifies connections between the cryosphere, water security, biodiversity and livelihoods. The report also emphasises that some environmental changes are irreversible over human timescales.[207]

The IPCC similarly finds that adaptation becomes more constrained and less effective with increasing global warming. Some ecosystems and human systems have already reached limits to adaptation. Further warming would increase the number of systems facing such limits.

For Planetary Transition, these findings establish a necessary boundary. The scenario does not assume that sufficient investment can preserve every settlement. It explores a future in which societies seek to reduce avoidable losses while recognising where continued residence may become unsafe or economically untenable. The capacity to distinguish between feasible adaptation and situations requiring relocation is therefore central.

2026-2040: Integrated adaptation becomes a policy priority

During the first period, governments continue responding to environmental pressures through existing institutions. Adaptation programmes address water management,

[206] Intergovernmental Panel on Climate Change (IPCC) (2023). *Climate Change 2023: Synthesis Report*. Summary for Policymakers, Sections B.4 and C.2–C.4. Geneva: IPCC. https://www.ipcc.ch/report/ar6/syr/summary-for-policymakers/

[207] Wester, P., Chaudhary, S., Chettri, N., Jackson, M., Maharjan, A., Nepal, S., & Steiner, J. F. (Eds.) (2023). *Water, Ice, Society, and Ecosystems in the Hindu Kush Himalaya: An Outlook*. Kathmandu: International Centre for Integrated Mountain Development. https://doi.org/10.53055/ICIMOD.1028

agriculture, disaster preparedness and infrastructure. However, many activities remain organised within separate administrative sectors.

Planetary Transition assumes that the limitations of fragmented approaches encourage greater coordination. Governments begin to connect water planning with land use, energy systems, agricultural development and the needs of local communities. These changes build on initiatives already under way.

The ICIMOD *Integrated Climate Adaptation Solutions for the Hindu Kush Himalaya Region* project, covering Bangladesh, Bhutan and Nepal from 2025 to 2029, combines springshed management, agrobiodiversity and renewable-energy-powered irrigation. The project emphasises community participation, including the leadership of women and Indigenous Peoples and Local Communities. It also seeks to strengthen the capacity of local institutions to obtain climate finance and implement adaptation measures.[208]

The initiative provides a contemporary example of integrated adaptation planning. However, its existence does not establish that the approach will achieve its intended outcomes or become widely implemented.

For Planetary Transition, it illustrates a possible institutional starting point. The scenario assumes that similar approaches are progressively incorporated into national and regional development policies. The emphasis shifts from responding to isolated environmental problems towards understanding how ecological and economic systems support settlement viability.

Water management and the restoration of ecological functions

Water availability is a central concern in the Hindu Kush Himalayan region. Changes in snow and glacier systems can influence seasonal water flows. Rainfall variability and land-use change may affect groundwater recharge and the reliability of springs. Agriculture, households, energy systems and ecosystems compete for water under different conditions.

Planetary Transition explores a response in which water governance combines infrastructure with the restoration and maintenance of ecological functions. This may include springshed management, watershed restoration, soil conservation and improved water storage. However, the effectiveness of individual measures depends on local hydrology and environmental conditions.

Restoring vegetation does not automatically increase water availability in every catchment. Similarly, constructing additional storage does not resolve all allocation conflicts. The relevant institutional development is the integration of scientific assessment, local knowledge and transparent procedures for distributing resources. Some communities may require infrastructure investment. Others may benefit from changes in land management or more efficient use of available water.

[208] International Centre for Integrated Mountain Development (ICIMOD) (2026). *Integrated Climate Adaptation Solutions for the Hindu Kush Himalaya Region (HI-CAS)*. Project documentation, February 2025-March 2029. https://www.icimod.org/integrated-adaptation-hi-cas/

The scenario assumes that public institutions increasingly evaluate these options together rather than treating each intervention as an independent solution.

Nature-based solutions and their limits

Nature-based solutions are frequently proposed as approaches for addressing climate risks while supporting ecosystems. They may involve the protection, restoration or improved management of forests, wetlands, grasslands and other ecosystems. Such interventions can support biodiversity and provide benefits related to water regulation, soil protection and human wellbeing.

The International Union for Conservation of Nature established its *Global Standard for Nature-based Solutions* to guide the design and assessment of such measures. The standard includes criteria concerning biodiversity, economic feasibility, inclusive governance, trade-offs and adaptive management.[209]

These criteria are relevant to Planetary Transition. They indicate that ecological restoration should not be assessed solely through environmental outcomes. Projects must also consider who controls land, who receives benefits and how costs are distributed. For example, restoring a catchment may require restrictions on grazing or changes in agricultural use.

These measures can affect households whose livelihoods depend on existing access arrangements. An intervention may therefore improve one ecological function while creating economic hardship for particular groups. The scenario assumes that institutions develop procedures for identifying and negotiating such effects. Ecological restoration becomes part of an integrated system of resource governance rather than a substitute for social and economic policy.

Shared resources and collective institutions

Chapter 4.4 examined historical and contemporary systems through which communities regulate access to land and other resources. The Amazigh Agdal system and the Allmende of Southern Germany and Switzerland demonstrate that ownership and rights of use can be organised through collective institutions. Such arrangements may support resource management without requiring exclusive individual ownership of every resource. However, collective institutions can also restrict access through established membership rules.

Their relevance to Planetary Transition therefore lies in the principles of governance rather than in the direct transfer of historical practices. Elinor Ostrom's research provides a wider analytical framework. In *Governing the Commons* (1990), Ostrom examined institutions through which resource users successfully managed shared resources over extended periods. Her work identified the importance of rules adapted to local conditions, participation in decisions, monitoring and accessible conflict-resolution mechanisms.[210]

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[209] International Union for Conservation of Nature (IUCN) (2020). *IUCN Global Standard for Nature-based Solutions: A User-friendly Framework for the Verification, Design and Scaling Up of NbS*. First edition. Gland: IUCN. https://doi.org/10.2305/IUCN.CH.2020.08.en

[210] Ostrom, E. (1990). *Governing the Commons: The Evolution of Institutions for Collective Action*. Cambridge: Cambridge University Press. https://doi.org/10.1017/CBO9780511807763

Ostrom did not argue that communal ownership always produces better outcomes than state or private management. Instead, her research demonstrated that different institutional arrangements can support collective resource governance under appropriate conditions.

For Planetary Transition, the implication is that resource management need not be organised exclusively through central state control or individual private ownership. Local institutions, public authorities and private actors may share responsibilities within clearly defined legal frameworks. The challenge is to maintain legitimate rights while responding to environmental change and the needs of additional resource users.

2041-2060: Adaptation changes local economic systems

During the second period, the scenario assumes that integrated adaptation has become an established component of economic development. Investment increasingly reflects long-term assessments of environmental risks and resource availability.

Agricultural production may incorporate changes in crop selection, water management and land use. Energy systems may become more diversified, with renewable technologies supporting local infrastructure and productive activities where economically and technically appropriate. Settlements may adapt building design, transport systems and public spaces to changing environmental conditions.

These changes would not eliminate the need for fixed infrastructure. They would modify the conditions under which it is planned and maintained. The IPCC identifies several adaptation measures with documented benefits, including agroforestry, farm diversification, soil moisture conservation and ecosystem-based approaches. It also notes that effectiveness varies and may decline with increasing warming.

For Planetary Transition, the scenario assumes that these measures are applied selectively according to local conditions. The objective is to strengthen the economic foundations of settlements rather than maintain every existing activity unchanged. Some livelihoods may remain viable through adaptation. Others may require substantial changes or the development of alternative economic opportunities.

Circular resource use and infrastructure

Long-term settlement viability depends partly on the efficient use and maintenance of material resources. Infrastructure requires construction materials, energy and continuing investment. Housing, transport and water systems also create demand for land and affect surrounding ecosystems.

In Planetary Transition, circular resource management becomes a more significant consideration in public procurement and economic planning. Buildings and infrastructure may be designed for maintenance, repair and longer service life. Construction materials may be recovered and reused where this is technically feasible and environmentally justified. Water reuse and improved wastewater treatment may support resource efficiency in suitable settings.

However, circularity does not eliminate all demand for primary materials or energy. Recycling and reuse involve collection, processing and transport. Their environmental

benefits depend on the materials, technologies and local conditions involved. The scenario therefore does not assume that circular economic practices remove physical resource constraints.

It explores how improved material management could reduce some demands on natural resources and contribute to the long-term maintenance of settlements.

Adaptation finance and unequal capacity

Planetary Transition would require substantial investment. Local governments may need resources for water infrastructure, housing adaptation, ecosystem restoration and disaster preparedness. Agricultural communities may require financing to modify production systems. Regions already experiencing economic difficulties may have limited capacity to fund such changes.

The United Nations Environment Programme's *Adaptation Gap Report 2026*, published on 4 November 2026, documents the continuing difference between adaptation finance needs and available international public funding. The report estimates international public adaptation finance flows from developed to developing countries at approximately USD 28.2–31.7 billion in 2024. Estimated adaptation needs in developing countries reach approximately USD 305 billion annually by 2035. The report also identifies institutional barriers that limit the implementation of adaptation measures.[211]

These figures demonstrate the scale of the present financing challenge. They should not be interpreted as a calculation of the investment required for Planetary Transition by 2100. The scenario assumes that governments and financial institutions develop more reliable arrangements for financing adaptation over longer periods. Possible mechanisms could include public investment, international cooperation, risk-sharing instruments and funding linked to local development plans.

However, the costs and benefits of such arrangements would remain uneven. The ability of poorer regions to participate would depend on access to finance and the distribution of financial responsibilities.

Who pays for preserving settlements?

Investment in adaptation raises questions about fairness. A government may be able to protect several settlements but lack sufficient resources to finance every proposed measure. Some locations may require relatively limited investment. Others may face repeated hazards or infrastructure costs that increase over time. Decisions about investment priorities would therefore affect property values, employment opportunities and the ability of communities to remain in place.

Planetary Transition does not eliminate these choices. Instead, it assumes that public authorities develop transparent procedures for evaluating adaptation options and their distributional consequences. These procedures could consider the costs of maintaining

[211] United Nations Environment Programme (UNEP) (2026). *Adaptation Gap Report 2026: Ready? Not. Climate Impacts Will Not Wait. Adaptation Finance Must Rise*. Nairobi: UNEP. Published 4 November 2026. https://wedocs.unep.org/handle/20.500.11822/50093

infrastructure, the availability of alternative livelihoods and the preferences of affected populations.

However, economic assessments alone cannot determine the legitimacy of a decision. Communities may have cultural, historical and social relationships with places that are not adequately represented through property values or conventional cost-benefit calculations. For TEOS 2100, the institutional challenge is to combine financial responsibility with meaningful participation and protection of recognised rights.

The limits of adaptation and the possibility of relocation

An emphasis on preserving viable settlements can create a risk of maintaining infrastructure in locations where continued residence becomes increasingly dangerous. Public investment may reduce exposure in the short term while encouraging further development in areas facing long-term hazards.

The IPCC identifies such outcomes as forms of maladaptation. Measures can increase future vulnerability when they create dependence on infrastructure or land uses that become difficult to maintain. The assessment emphasises the value of flexible, long-term planning that preserves options as environmental conditions change.[212]

For Planetary Transition, the right to remain cannot mean an obligation for institutions to guarantee permanent residence under all circumstances. Where adaptation reaches physical or practical limits, relocation may become necessary. The challenge is to recognise these limits without prematurely abandoning communities that retain viable options.

Planned relocation can involve complex questions concerning property, livelihoods, compensation and cultural identity. Guidance developed by UNHCR, Georgetown University and the Brookings Institution addresses the protection of people displaced through planned relocation in the context of disasters and environmental change. It emphasises participation, human rights and careful consideration of the consequences for affected communities.[213]

For Planetary Transition, relocation remains an available response, but it is not treated as the default solution.

2061-2080: A diversified landscape of adaptation

During the third period, the scenario assumes that different forms of adaptation have produced varied outcomes. Some settlements have maintained viable living conditions through infrastructure investment and ecological management. Others have changed their economic functions or population size.

[212] Intergovernmental Panel on Climate Change (IPCC) (2023). *Climate Change 2023: Synthesis Report*. Summary for Policymakers, Section B.4: Adaptation Options and Their Limits in a Warmer World. https://www.ipcc.ch/report/ar6/syr/summary-for-policymakers/

[213] UNHCR, Brookings Institution, & Georgetown University (2015). *Guidance on Protecting People from Disasters and Environmental Change through Planned Relocation*. Geneva and Washington, DC. https://www.brookings.edu/articles/guidance-on-protecting-people-from-disasters-and-environmental-change-through-planned-relocation/

A number of communities may have relocated because adaptation proved insufficient. The resulting settlement landscape is neither static nor uniformly mobile. Some regions retain established populations and economic activities. Others become connected through seasonal employment, circular migration and shared infrastructure.

Public institutions coordinate these different patterns. Governments may support settlement adaptation while also maintaining legal pathways for people who need to move. Local and regional authorities may manage shared resources through arrangements that recognise both established users and newcomers.

Such coordination requires continuing political negotiation. Changes in water availability may generate disputes between agricultural and urban users. Ecological restoration projects may affect access to land. Receiving settlements may face pressure to expand housing and public services.

Planetary Transition is therefore not a society without resource competition. It is a society in which institutions have developed greater capacity to address such conflicts through recognised procedures and public participation.

Polycentric governance and regional cooperation

The institutional arrangements of Planetary Transition would extend across several levels of authority. Local communities may manage certain shared resources. Municipalities may coordinate housing, water services and infrastructure. National governments retain responsibility for legislation, public finance and international relations. Regional institutions may address shared river systems, transport and environmental monitoring.

This resembles the concept of polycentric governance developed in institutional research. Ostrom's work demonstrates that systems involving multiple centres of decision-making can provide alternatives to purely centralised administration. However, multiple institutions do not automatically produce effective coordination. Responsibilities must be clear, and mechanisms are needed to resolve disagreement between authorities.

For Planetary Transition, polycentric governance is a possible organising principle rather than an assumed institutional achievement. The scenario explores cooperation in which decisions are made at levels appropriate to their effects, while larger institutions provide resources, legal protection and coordination.

This could allow local knowledge to inform resource management without placing the full financial and administrative burden on communities.

Relations between mountain and downstream regions

The Hindu Kush Himalayan region illustrates the importance of cooperation across ecological and political boundaries. Mountain ecosystems influence water availability, sediment transport and other processes affecting downstream regions. Changes in land use and infrastructure can create effects extending beyond local jurisdictions.

Planetary Transition assumes that these relationships receive greater attention in regional governance. Governments may coordinate hydrological monitoring, infrastructure planning

and disaster preparedness. Agreements could address the distribution of benefits and costs associated with river-basin development. However, the existence of shared environmental interests does not eliminate differences in national priorities. Upstream and downstream countries may continue to disagree over water allocation or infrastructure development.

For TEOS 2100, the relevant change is that cooperative procedures become more established and are supported by stronger institutions. The scenario does not require the disappearance of national sovereignty. It explores whether sovereign states can manage environmental interdependence more effectively through sustained cooperation.

Social rights and participation

Planetary Transition places substantial emphasis on maintaining viable settlements. However, this does not imply that access to rights should depend exclusively on permanent residence. People may still move for employment, education, family relationships or environmental reasons. Some households may maintain livelihoods across several locations.

The institutional principles developed in Chapters 5.1–5.5 therefore remain relevant. Education systems need to recognise previous learning. Social protection may require coordination across jurisdictions. Healthcare records and essential services must remain accessible during movement. Political participation must account for people whose lives extend beyond one location.

For Planetary Transition, the principal difference concerns the relationship between mobility and adaptation. Institutions seek to preserve meaningful opportunities to remain while maintaining rights for those who move. The social objective is not to favour settlement over mobility as a moral principle.

It is to prevent environmental and economic conditions from unnecessarily removing people's choices.

2081-2100: Settlement viability as a shared responsibility

By the final period, the scenario has developed into a system in which settlement adaptation and resource governance are closely connected. Some communities occupy locations that have been maintained through sustained investment and ecological management. Infrastructure has been modified to respond to changing environmental conditions.

Agricultural and economic activities reflect the availability of resources and the need to protect essential ecosystem functions. Public services remain associated with settlements, but institutional arrangements accommodate people who move between them.

Collective and individual rights of resource use coexist within legal frameworks. Community organisations participate in certain management decisions, while public authorities retain responsibility for essential infrastructure and rights protection. However, the resulting society is not free from inequality. Some regions possess stronger economies or more favourable environmental conditions. Others require continuing financial support.

Disputes over land, resource allocation and public expenditure remain. The scenario assumes that institutions have developed greater capacity to manage these differences through negotiation, transparent rules and public participation. The distinguishing characteristic is not the complete restoration of environmental conditions. It is the attempt to maintain secure and inclusive living conditions despite environmental change.

The risk of an idealised transition

Planetary Transition could easily become a narrative in which cooperation and ecological management resolve all major difficulties. Such an interpretation would be inconsistent with the evidence examined in this report. The IPCC identifies physical limits to adaptation. UNEP documents substantial financial and institutional gaps. Existing commons arrangements demonstrate that collective resource management can protect established users while excluding newcomers. Public participation may improve decision-making but cannot eliminate conflicting interests.

Planetary Transition must therefore account for the possibility that individual adaptation programmes fail or generate unintended effects. A restoration project may not produce the expected ecological benefits. Infrastructure investments may exceed available budgets. A community may oppose changes required for ecological management. Governments may disagree over shared resources.

These difficulties are not exceptions to the scenario. They are part of the conditions under which its institutions operate. The defining assumption is that societies retain sufficient political and administrative capacity to respond, revise decisions and negotiate competing interests.

Human Implications

In Planetary Transition, everyday life remains closely connected to settlements, local resources and established communities. However, these relationships have changed through decades of adaptation.

A farmer may work land managed through a combination of family ownership and communal resource-use agreements. Water access depends on rules developed by local institutions and supported by regional infrastructure. Ecological restoration may have improved some conditions while introducing restrictions on how land can be used. The farmer benefits from a more reliable livelihood but remains responsible for adapting production to changing resource availability.

A second person may arrive temporarily from another region. Their access to housing, employment and shared resources must be negotiated with established residents. The community faces a choice between protecting existing entitlements and accommodating additional users.

Neither decision is without consequences. Chapter 7 examines these conditions through the experiences of a farmer involved in collective resource management and a temporary resident seeking access to local opportunities. Their stories explore how cooperation can

expand security while leaving difficult questions concerning rights, membership and resource allocation.

Implications for TEOS 2100

Planetary Transition represents a possible future in which societies respond to environmental insecurity by investing in the viability of settlements and the ecological systems supporting them. Its institutional foundation is coordinated governance. Governments, communities and economic actors seek to manage resources through integrated planning, recognised rights and longer-term investment.

Existing research and programmes provide starting points. The IPCC identifies opportunities for climate-resilient development and the limits of adaptation. ICIMOD's regional initiatives demonstrate how water management, agriculture, renewable energy and community participation can be combined within practical programmes. Ostrom's institutional research provides principles for understanding collective resource management. UNEP's assessment of adaptation finance demonstrates the scale of the resources and administrative capacity required.

These examples do not establish that Planetary Transition will occur. They show that its central institutional ideas have precedents in contemporary research and practice. For TEOS 2100, the scenario explores whether such approaches could maintain viable living conditions in a wider range of places while reducing avoidable displacement. It does not assume that all settlements can be preserved.

Where environmental limits are reached, people may still need to move. The distinguishing objective is to ensure that decisions about remaining or relocating are informed by environmental evidence, recognised rights and the interests of affected communities. Planetary Transition therefore offers a contrasting perspective to the other three futures.

- *Fortress Earth* protects selected settlements through exclusion.
- *Negotiated Mobility* expands recognised rights across jurisdictions.
- *Networked Nomads* enables economic movement through transnational networks while leaving institutional protection fragmented.
- *Planetary Transition* explores whether cooperative adaptation can maintain secure relationships between people, resources and places without making permanent residence compulsory or mobility unavoidable.

The following section compares the four scenarios through their implications for human living conditions, institutional responsibilities and the distribution of rights.

6.6 Scenario Comparison Table

The four scenarios developed in this chapter describe contrasting ways in which societies might respond to environmental change and increasing pressure on viable settlement space. They share a common environmental starting point but differ in their approaches to governance, resource management, mobility and social participation.

- *Fortress Earth* explores territorial protection through selective access and political exclusion.

- *Negotiated Mobility* examines cooperation between states that enables people to move while maintaining recognised rights.
- *Networked Nomads* considers extensive economic and digital connectivity without corresponding institutional protection.
- *Planetary Transition* explores coordinated adaptation intended to preserve viable settlements and maintain access to essential resources.

These futures should not be interpreted as mutually exclusive developments across the entire planet. Different regions could exhibit characteristics of several scenarios at the same time. Institutional arrangements may also change during the period examined.

The purpose of comparison is therefore not to identify which scenario is most likely to occur. It is to examine how different institutional conditions may affect the ability of people to maintain secure livelihoods, exercise rights and participate in society.

Comparing the four institutional futures

The first comparison concerns the organisation of political authority, settlement adaptation and access to resources.

Table 6.1. Institutional characteristics of the four TEOS 2100 scenarios

Source: TEOS 2100, own scenario framework (2026). Based on the environmental and institutional analysis developed in Chapters 1-5.

Dimension	Fortress Earth	Negotiated Mobility	Networked Nomads	Planetary Transition
Governance	Territorial, restrictive and selectively protective	Treaty-based, cooperative and multi-level	Fragmented, with strong private network coordination	Cooperative, polycentric and oriented towards long-term adaptation
Dominant adaptation approach	Protection of selected settlements	Organised mobility between viable locations	Diversification of livelihoods through networks and mobility	Preservation and improvement of settlement viability
Role of the state	Controls territory and access to essential resources	Coordinates rights and responsibilities with other states	Regulates territory while economic networks operate internationally	Coordinates public investment, resource management and institutional cooperation
Mobility	Restricted and dependent on recognised status	Legally organised through bilateral and regional arrangements	Flexible for some, precarious for others	Available as an option alongside place-based adaptation

Water and land access	Selective allocation, with priority for protected areas	Shared arrangements and negotiated allocation	Uneven access through national, local and commercial systems	Integrated management combining public authority and recognised collective or individual rights
Technology	Supports infrastructure protection, administration and control	Supports coordination and portability of services	Enables employment networks and access to commercial services	Supports adaptation, environmental monitoring and efficient resource use
International cooperation	Limited or contested where national priorities dominate	Central to migration and resource governance	Strong economic connectivity, weaker coordination of social rights	Focused on adaptation, shared ecosystems and long-term development
Principal institutional risk	Exclusion and unequal protection	Breakdown or uneven implementation of agreements	Economic dependence without adequate rights	Insufficient finance, institutional complexity and limits to adaptation

The table illustrates that each scenario contains institutions capable of maintaining some forms of economic and social activity.

The differences concern the distribution of their benefits and the conditions under which people may participate.

- *Fortress Earth* may preserve technologically advanced settlements while excluding people without recognised status.
- *Negotiated Mobility* may support extensive legal movement but remain vulnerable to political disagreement and unequal administrative capacity.
- *Networked Nomads* may provide opportunities for employment across geographical boundaries while leaving workers dependent on commercial systems.
- *Planetary Transition* may maintain viable settlements through adaptation but face difficult choices concerning investment, land use and relocation.

The presence of functioning institutions is therefore not sufficient to establish that a society provides secure living conditions for all its members.

Comparing human living conditions

The second comparison examines how institutional arrangements affect everyday life. The analysis follows the principles developed in Chapter 5, with particular attention to residence, resources, rights and social participation.

Table 6.2. Human living conditions under the four scenarios

Source: TEOS 2100, own comparative assessment (2026). These characteristics describe scenario assumptions, not empirically observed conditions in 2100.

Human condition	Fortress Earth	Negotiated Mobility	Networked Nomads	Planetary Transition
Housing and residence	Secure in protected areas; restricted or precarious elsewhere	Residence rights supported by agreements, subject to eligibility and housing capacity	Temporary and flexible housing arrangements, often linked to income	Settlement security supported by adaptation and negotiated access
Water and food security	Unequal access determined by allocation priorities	Access coordinated across jurisdictions but subject to resource constraints	Depends on location, income and available networks	Supported through integrated resource management, with environmental limits
Employment and income	Opportunities concentrated in protected areas; insecure work elsewhere	Employment pathways governed by agreements and labour protections	Extensive network-based opportunities, with variable income security	Livelihoods supported by adaptation, local development and diversification
Social protection	Unequal and strongly linked to eligibility or residence	Certain entitlements coordinated across participating jurisdictions	Fragmented across employment and national systems	Public provision strengthened through local and national institutions
Education	Reliable in protected settlements; interrupted or restricted elsewhere	Learning records and access coordinated across jurisdictions	Digital learning opportunities, with uneven recognition and access	Education maintained through public investment and flexible provision
Healthcare	Advanced facilities for recognised users; gaps for excluded groups	Coordination of coverage and records where agreements exist	Digital access may expand, while coverage remains uneven	Healthcare integrated into settlement and regional adaptation planning
Political participation	Limited for excluded and temporary populations	Maintained through national institutions and selected participation arrangements	Often weaker than economic participation	Supported through community and multi-level governance

Social belonging	Divisions between protected and marginalised populations	Connections to home and receiving communities can coexist	Transnational networks coexist with uncertain local membership	Local and collective relationships are maintained while accommodating mobility
Individual choice	Strongly constrained by status and territorial rules	Expanded through recognised mobility pathways	Uneven, depending on skills, income and network access	Supported by the possibility to remain or move where viable alternatives exist

The comparison demonstrates that mobility is not equivalent to freedom. A person may be able to travel frequently while lacking stable employment, healthcare or residence rights. Conversely, a person who remains in one location may have substantial security and opportunities for participation, provided that essential resources and institutions remain accessible.

The relevant distinction is therefore not simply between settled and mobile populations. It concerns the ability of individuals and households to maintain viable lives under different institutional conditions.

Unequal outcomes within each scenario

Each scenario contains internal inequalities.

- In *Fortress Earth*, people living in protected settlements may enjoy reliable infrastructure and public services. Others may be excluded from these benefits despite contributing to the same economy.
- In *Negotiated Mobility*, citizens of participating countries may gain access to regular employment and residence pathways. People outside the scope of agreements may continue to face substantial barriers.
- In *Networked Nomads*, qualified workers with strong professional networks may benefit from geographical flexibility. Workers without comparable resources may experience insecure employment and dependence on commercial platforms.
- In *Planetary Transition*, established communities may benefit from public investment and collective resource management. However, newcomers may encounter restrictions linked to membership or established land-use rights.

These inequalities matter because institutional arrangements cannot be assessed only through their average outcomes. A system may maintain economic productivity while failing to secure access to essential resources for parts of the population. Another may provide extensive formal rights without ensuring sufficient infrastructure or finance to make those rights effective.

The comparison therefore considers both the availability of opportunities and their distribution.

The relationship between settlement viability and mobility

The four scenarios also illustrate different relationships between the protection of settlements and the ability to move.

- *Fortress Earth* concentrates adaptation in selected locations. Mobility may be necessary for people outside these areas, yet opportunities to enter protected settlements remain restricted.
- *Negotiated Mobility* accepts that some movement will be required and develops arrangements to make it more secure.
- *Networked Nomads* creates economic opportunities across locations without necessarily providing stable residence or social protection.
- *Planetary Transition* places greater emphasis on preserving viable living conditions through adaptation while maintaining mobility as an option.

These differences are not determined by environmental pressures alone. They reflect institutional choices concerning investment, rights and the organisation of public services.

The capacity to remain in a settlement may depend on infrastructure and resource access. The capacity to move may depend on legal status, financial resources and the availability of viable destinations. For TEOS 2100, both capacities are relevant to human security.

Identifying critical institutional dependencies

The comparison reveals several dependencies that extend across all four scenarios.

Access to essential resources remains a requirement regardless of whether a population is settled or mobile. Water, food, energy and housing cannot be replaced by legal or digital arrangements alone.

Continuity of recognised rights determines whether people can maintain access to employment, education, healthcare and social protection when their circumstances change.

Institutional accountability influences whether decisions concerning resource allocation or access to services can be challenged.

Public finance and infrastructure determine whether formally recognised rights can be implemented in practice.

Social relationships and participation influence whether people can maintain a sense of belonging and contribute to decisions affecting their lives.

These dependencies are present in each scenario, but the institutions responsible for addressing them differ.

- In Fortress Earth, responsibilities are concentrated within protected jurisdictions.
- In Negotiated Mobility, they are distributed through agreements between public authorities.
- In Networked Nomads, some functions are increasingly coordinated through commercial networks while legal responsibilities remain fragmented.
- In Planetary Transition, institutions seek to coordinate responsibilities around settlement adaptation and collective resource management.

The effectiveness of each arrangement depends on whether these responsibilities can be fulfilled under changing environmental and economic conditions.

From scenarios to human experiences

The institutional comparison provides the foundation for the Human Stories developed in Chapter 7. Each scenario is examined through two fictional perspectives. The characters do not represent statistically typical individuals or provide predictions about the lives of future populations. They are constructed to explore how different positions within a society affect access to rights, resources and opportunities.

A common narrative principle is used. Each character faces a concrete decision involving a limited number of available choices. The consequences of the decision depend on the institutions, resources and social relationships established in the relevant scenario. One perspective examines access to security or opportunity within the system. The other examines a situation in which rights, resources or participation are more constrained or contested.

The intention is to make inequalities and institutional trade-offs visible without reducing individual characters to illustrations of abstract concepts.

Table 6.3. Human perspectives for Chapter 7

Source: TEOS 2100, proposed narrative framework for Chapter 7 (2026). All characters and situations are fictional.

Scenario	Human perspective	Central decision or conflict
Fortress Earth	A mobile educator working with children outside protected settlements	Whether to cross a restricted boundary to obtain essential resources and continue teaching
Fortress Earth	A resident of a protected urban area	Whether to challenge a resource-allocation decision that protects her community but disadvantages neighbouring populations
Negotiated Mobility	A family maintaining livelihoods across two countries	Whether to use a negotiated relocation pathway while preserving family, property and social relationships at home
Negotiated Mobility	A municipal official in a receiving region	How to implement mobility rights when housing, schools and public finances are under pressure
Networked Nomads	A skilled technician working through international digital networks	How to respond when an infrastructure or platform failure threatens employment and mobility
Networked Nomads	A temporary migrant worker with limited social protection	Whether to accept an insecure assignment to maintain income and support relatives

Planetary Transition	A farmer participating in community-based resource management	How to maintain her livelihood while accepting changes in land use and water allocation
Planetary Transition	A temporary resident seeking access to a collectively managed region	How to negotiate access and participation without displacing established community rights

The stories will be developed as independent narratives, while retaining a shared set of questions.

- What does the character need?
- Which resources and rights are available?
- Who has the authority to make relevant decisions?
- What options remain when an institutional arrangement fails or a conflict arises?

The answers will vary across the scenarios. Their comparison provides a further way of testing whether the institutional conditions described in Chapter 6 are internally consistent.

Scenarios as analytical alternatives and possible regional realities

The four futures are developed as alternative scenarios for analytical purposes. However, their defining features need not be geographically uniform. A society characterised by extensive cooperation may coexist with a neighbouring jurisdiction maintaining restrictive mobility policies. Private digital networks may operate across countries with very different systems of political participation. A region pursuing ecological restoration may depend economically on industries located in areas governed through other institutional arrangements.

Such combinations could create tensions and dependencies beyond those examined within individual scenarios. For TEOS 2100, these relationships are relevant to the wider global implications of settlement change. The Hindu Kush Himalayan region does not exist independently of international labour markets, energy systems, trade and political institutions.

The future of its settlements and communities may therefore be affected by decisions made far beyond the region. Nevertheless, the analytical value of the four scenarios depends on maintaining their distinct institutional assumptions. The possibility of coexistence should be treated as an additional consideration rather than a reason to merge the scenarios into one predicted global future.

Implications for TEOS 2100

The four scenarios demonstrate that the consequences of environmental change for human settlement cannot be assessed through environmental indicators alone. A settlement may remain physically viable while its inhabitants face restrictions on essential resources or political participation. A mobile population may maintain economic activity across several jurisdictions while lacking secure access to housing, healthcare or social protection.

Conversely, institutions may improve settlement viability through adaptation or support mobility through agreements that preserve recognised rights.

These possibilities depend on political decisions, economic resources and institutional arrangements. For TEOS 2100, the defining question is whether people can maintain secure lives under changing conditions. This requires access to essential resources, recognised rights, viable livelihoods and opportunities for social participation. It also involves the ability to make meaningful choices about remaining, moving temporarily or relocating.

None of the four scenarios provides an automatic solution to these requirements.

- *Fortress Earth* can maintain viable settlements while creating substantial exclusion.
- *Negotiated Mobility* can expand opportunities but remains dependent on sustained cooperation.
- *Networked Nomads* can increase economic flexibility while producing new forms of dependence and insecurity.
- *Planetary Transition* can strengthen local adaptation but remains constrained by environmental limits, financial resources and competing interests.

Their comparison shows that the possible emergence of a Post-Settlement Civilisation is not determined by mobility alone. It concerns the changing relationship between people, places and the institutions that organise their lives.

The Human Stories presented in the following chapter examine this relationship through individual decisions and experiences in the year 2100.

7. Human Stories from 2100

The four scenarios presented in Chapter 6 describe different ways in which societies might respond to environmental change, shifting settlement conditions and the growing importance of mobility. They examine institutions, resources and the distribution of rights. Yet these structures become meaningful through the lives of the people who depend on them.

This chapter moves from institutional analysis to imagined human experience. Eight fictional stories explore life in the year 2100. Each is situated within one of the four scenarios and follows a person facing a decision shaped by the conditions of that future. The stories are not predictions. Their characters, conversations and individual events are invented. The institutional settings are derived from the scenario assumptions developed in Chapter 6.

Each story presents a limited perspective. No character fully understands the political or environmental systems affecting their life. They know what they have experienced, what others have told them and what they must decide. The stories also explore inequalities within each scenario. Two people living under the same institutional arrangements may have very different opportunities depending on their resources, legal status, occupation and relationships.

Some characters may share similar concerns across the four futures. Others may be connected through comparable decisions about water, work, education or the places they call home. Together, the stories ask a question that extends beyond the survival of settlements: what does it mean to have a viable life when the relationship between people and places is changing? All characters and visual depictions in this chapter are fictional constructions created for TEOS 2100.

7.1 The Last Lession

Figure 7.1. Nyima, a mobile educator in the Fortress Earth scenario, 2100.

Fictional future visualisation created for TEOS 2100.



Nyima had promised the children she would come on Thursday. It was Thursday, and she was still on the wrong side of the gate.

The checkpoint stood where the old road entered the valley. Its concrete buildings were low and windowless, built into a slope that had once been a pasture. A metal barrier crossed the road. Beyond it, the mountains rose towards the morning light. She had reached the checkpoint shortly after six. Now it was nearly eight, and the young officer behind the desk had examined her papers three times.

“Your teaching permit is valid,” he said.
“I know.”
“But your movement authorisation expired yesterday.”
“I submitted the renewal last week.”
“It hasn't been approved.”

Nyima placed her hand on the case beside her chair. Inside were two reading tablets, notebooks, a small projector and a collection of illustrated books. The tablets were old, but they still worked. She had spent the previous evening charging their batteries.

“The children are waiting at Kharu,” she said. “I teach there every Thursday.”

The officer looked at his screen. “Kharu is outside the registered service area.”

“It has been outside the registered service area for seventeen years.”

He did not answer.

There had once been a school building in Kharu. Nyima remembered it from her first posting. The roof had leaked in spring, and the classrooms were cold, but there were windows and a playground. The school closed when the last permanent households left. Some families had moved to the protected settlements farther south. Others continued to follow seasonal grazing routes through the upper valleys. The children had followed their parents, and Nyima had followed the children.

At first, she had travelled with a small team of teachers. Later, when the education service reduced its mobile provision, she worked alone. She taught children of different ages together, moving between reading, arithmetic and whatever questions they brought from home. Some weeks they studied inside a community shelter. In summer, they sat outside. A teacher could work without a building. She had discovered that years ago. Working without permission was another matter.

The officer turned his screen towards her. “Your route is approved up to Boundary Twelve. You can teach there.”

“There are no children at Boundary Twelve.”
“Then you need a revised service allocation.”
“How long will that take?”
“I can't tell you.”

Nyima knew the procedure. She had completed it many times. Every time a settlement changed its registered location or a grazing route crossed an administrative boundary, the same documents had to be submitted. The children were not registered in one place for long enough to satisfy the system.

She collected her papers and stepped outside. A line of vehicles waited along the road. Most were carrying goods for the protected settlements. A smaller vehicle with water containers stood behind a maintenance truck. The driver recognised her.

“Still here?”
“They won't let me through.”

He shook his head. “I've got a delivery beyond the gate. Perhaps you can come with me.”

“Your authorisation doesn't cover passengers.”

He gave her a tired smile. “Since when did you start worrying about that?”

Nyima looked towards the barrier. “I've always worried about it.”

The driver returned to his vehicle. She sat on a low wall and opened a message from Tsering, one of the older pupils.

Are you coming? Pema has finished the book.

Pema was nine and had struggled with reading for almost two years. In the previous lesson he had finally read an entire page without asking for help. Nyima had given him a short illustrated story and told him to finish it before Thursday.

She typed a reply. *I'm at the checkpoint. There is a problem with my permit.*

The message remained unsent until the signal returned. Another message arrived from the education office. Her renewal application was still under review. No explanation was provided.

Nyima called the regional coordinator. “I can see the application,” he said. “It is waiting for territorial approval.”

“They've already approved my teaching permit.”
“Teaching approval and movement approval are different.”
“I know they're different. I'm asking why I need both to teach the same children.”

There was a pause. “I understand your situation, Nyima.”

“Then help me.”
“I can request an exception. But I can't authorise it myself.”
“When?”
“Possibly tomorrow.”

Tomorrow, the families would be moving again.

Nyima ended the call and opened the class register. Twelve children were listed for Kharu. Nine had attended the previous lesson. Two were absent because their families had travelled to another grazing area. One had been ill. Next to each name, Nyima kept handwritten notes about their progress.

The official system recorded completed modules. It did not record that Pema read more confidently when his older sister was nearby, or that Dolma could explain difficult fractions using the distribution of food between animals. Those were things a teacher needed to know.

Across the road, a woman emerged from a passenger vehicle with a little boy. She approached the checkpoint carrying a bag and a folded document. The officer scanned her identification.

“Your son can enter,” he said. “You cannot.”
“He's seven.”
“His educational residence has been approved. Your accompanying residence has not.”

The woman stood still. The boy held her sleeve. Nyima watched them move to the side of the building. The woman made a call, then another. The child sat on their bag.

Nyima had seen similar situations before. Sometimes the missing authorisation appeared within hours. Sometimes families waited for days.

The protected settlements had good schools. Their teachers received regular salaries, and children could attend classes without travelling between valleys. A place had been offered to Nyima several years earlier. She had visited the school, walked through its bright corridors and spoken with the headteacher. The classrooms had functioning heating and a library. The children had meals and access to medical care.

She had almost accepted. Then she had thought about the pupils who would remain outside the service area. The offer had not included them.

At half past nine, Tsering's reply arrived.

We can wait.

Nyima looked at the words for a long time. Waiting was something the children had learned very young. They waited for transport and water deliveries. They waited for adults to return from seasonal work. They waited for permits, repairs and news from relatives who had moved to protected towns. Sometimes they waited for teachers.

She packed the register into her case and went back inside.

“I want to speak to the supervisor,” she told the officer.
“He's occupied.”
I'll wait.”

Another hour passed. The supervisor eventually appeared, carrying a mug of tea. He was older than the first officer, with a deep crease across his forehead. Nyima explained her situation, and he listened without interruption.

“Your work matters,” he said. “But the restriction applies to everyone.”
“The families aren't moving because they want to break a regulation.”
“That isn't the issue.”
“Then what is?”
“The zone has a limited water allocation. All non-resident movement requires approval.”
“I carry my own drinking water.”
“And if your vehicle breaks down? If you need medical assistance? If you stay overnight?”
“I've travelled this route for twenty-three years.”
“I believe you.”

He returned the documents. “I'm not authorised to make an exception.”

Nyima looked at the permits in her hand. For years she had assumed that if she explained the circumstances clearly enough, someone would find a way through the regulations. She no longer believed that. But she also knew the supervisor was not inventing the rules. He had a job, a family and limits on what he could decide.

She went outside again. The woman with the child was still waiting. Nyima sat beside them.

“Is he starting school?” she asked.
The woman nodded. “They offered him a place. We sold most of our animals to pay for the move.”
“And now?”
“They say I need another authorisation.”

The little boy was drawing lines in the dust with his finger.

“What's your name?” Nyima asked.
“Sonam.”

“What are you drawing?”
“A river.”

The lines branched and rejoined, running around stones and the legs of the bench.

“Where does it go?”
He pointed beyond the barrier. “To the city.”

Nyima watched the boy add another branch. Then she opened her case and took out one of the illustrated books.

“Would you like to read?”

He nodded.

They began with the first page. Soon two other children from the waiting vehicles came over. One sat beside Sonam. The other stood behind Nyima and looked over her shoulder. She read slowly, allowing them to finish sentences.

The supervisor passed the doorway and stopped.

“You can't conduct an unauthorised class here.”
Nyima closed the book. “I'm reading to the children.”
“This is a controlled area.”
“Then tell me where I may sit.”

He looked towards the vehicles, the waiting families and the narrow strip of road outside the barrier. After a moment, he pointed to a patch of ground beside the old maintenance shed.

“Over there. Away from the entrance.”

Nyima gathered the children and moved. The ground was uneven, and the morning sun had already warmed the stones. She placed her case against the wall and used it as a table. The children arranged themselves in a semicircle.

She asked their names. One of the younger girls said she had not been to school for six months. Another child had a reading record from a school in the southern district. Nyima examined it. He was working at approximately the same level as Tsering.

For the next hour, she taught. She had no official attendance register for these children, and the place was not recognised as a classroom. She could not issue certificates for their work. Nevertheless, they read, counted and argued about the answers to her questions.

At eleven, she received another message from Kharu.

We are leaving at noon.

There was a picture attached. The twelve children stood outside a low shelter, holding a hand-painted sign.

THANK YOU, NYIMA.

She enlarged the image. Pema was at the front, holding the book she had given him.

Nyima sat very still. The children beside her continued their exercise. She looked at the road beyond the gate. She could try to cross later with a delivery vehicle, but by then the families would be gone. If she entered without approval, she risked losing the permit that allowed her to teach at all.

She had spent years finding ways to work within the system. One unauthorised journey could end that work.

Nyima opened the class register and found Pema's name. She recorded the lesson as cancelled. Then she deleted the entry.

There had been a lesson today. It had simply happened in the wrong place.

She added a new note: *Three children at the checkpoint. Reading and arithmetic. Follow-up required.*

The system rejected the location. She wrote it in her notebook instead.

In the afternoon, the families departed. The little boy who had drawn the river waved through the window of a vehicle. His mother sat beside him, holding a temporary accompanying permit that had finally been issued.

Nyima stayed until the road was quiet. Before leaving, she sent a final message to Tsering.

I couldn't reach you today. Please tell Pema I would like to hear him read when we meet again.

The reply came almost immediately.

He already read the book to all of us.

Nyima smiled. Then she put the tablet away, lifted her case and began the journey home.

7.2 Behind the Gates

Figure 7.2. Mira, a water systems engineer in the protected city of Tashi, Fortress Earth scenario, 2100.

Fictional future visualisation created for TEOS 2100.



The water came on at six every morning.

Mira could hear it moving through the pipes behind the kitchen wall, a faint vibration that lasted only a few seconds before the pressure stabilised. She filled the kettle, washed two cups and set a bowl of fruit on the table. Outside, the city was waking beneath a pale sky. Electric buses moved along the avenue, and the trees in the central gardens were already receiving their morning irrigation.

Her daughter was sitting by the window, watching a maintenance drone travel slowly between the apartment buildings.

“Why does it always stop at that roof?” Anika asked.
“There's a pressure valve up there.”
“Is something wrong with it?”
“No. It checks the valve every morning.”

Anika considered this. “Even when nothing is wrong?”
“That's usually the best time to check.”

Mira smiled and placed a cup of tea beside her daughter. Anika was sixteen and had recently started asking questions about the city's infrastructure. For years, she had accepted the reliability of its services without thinking much about them. Now she wanted to know where the water came from, why the heating network was buried so deeply and what happened when the electricity failed.

Mira answered most of her questions. Others were more difficult.

The city of Tashi had been built around an older settlement at the edge of a mountain valley. Its original population had grown substantially during the second half of the century, when investment was concentrated in regions considered suitable for long-term habitation. New housing districts had been constructed on reinforced terraces. Water treatment facilities occupied the lower valley, and a system of reservoirs and storage tanks maintained supplies through periods of uncertain inflow.

Residents rarely experienced interruptions. Household allocations were monitored, but the basic allowance was sufficient for drinking, washing and ordinary domestic needs. Public schools operated throughout the year. The hospital had reliable electricity, and the transport network connected every residential district to the city centre.

Mira had helped design part of that system.

She was forty-eight and had worked for the Municipal Water Authority for more than twenty years. She knew which pumping stations required frequent repairs and which reservoirs lost the most water through evaporation. She also knew how little reserve capacity remained during prolonged dry periods.

Her work had taught her to distrust both reassurance and panic. Every system had limits. The question was whether people were willing to acknowledge them before those limits were reached.

At eight, she entered the control centre beneath the eastern administration building. The main display showed the city's water network as a series of coloured lines. Reservoir levels appeared in one column, expected demand in another. A separate panel displayed the condition of the intake channels farther up the valley.

Her colleague Dawa was waiting at the conference table.

“We have the new allocation figures,” he said.
Mira took off her coat. “How bad?”
“Not as bad as last month. Worse than the ministry expected.”

He sent the report to her screen. The upper reservoir remained below its seasonal target. Forecast inflows had been revised downward, and the authority's contingency reserve would fall below the required threshold unless consumption was reduced or additional water was diverted from elsewhere.

Mira studied the figures.

“Where does the additional allocation come from?”
Dawa hesitated. “The outer catchment.”

She opened the map.

The outer catchment lay beyond the city's protected boundary. It included several agricultural communities, temporary grazing areas and a small number of settlements that had never been incorporated into the municipal service system.

The water from those areas entered the same river basin that supplied Tashi. Some of it was already diverted through canals and storage facilities controlled by the regional authority.

A new directive proposed increasing the diversion during the next six months.

Mira read the conditions attached to the order.

“Has anyone assessed the downstream agricultural demand?”
“The regional office says the non-municipal allocation has been adjusted.”
“That isn't an assessment.”
“It's the decision.”

She leaned back in her chair. The figures were internally consistent. If the additional diversion proceeded, Tashi would maintain its required reserve. Domestic supply would remain stable, and restrictions on industrial water use could be postponed.

The calculation was sound.

What it did not show was how the adjustment would affect the people whose water had been reassigned.

At the morning briefing, the director presented the proposal as a routine security measure. The city was entering the dry season with a lower reserve than planned, and the regional authority had approved temporary changes to the allocation system.

“No interruption to residential supply is anticipated,” he said.

A representative from the health department nodded. The hospital could not tolerate reduced water pressure during sterilisation cycles. The food storage district also required dependable supplies.

Mira understood these concerns. She had argued for the same safeguards in previous years.

When questions were invited, she raised her hand.

“Have the users in the outer catchment been notified?”
The director looked at her. “The regional authority is responsible for external users.”
“Do we know what the reduction means for them?”
“We have their registered allocations.”
“Not their actual demand.”

He glanced towards the other officials. “Our responsibility is to maintain the municipal reserve.”

Mira said nothing further. She had worked with the director for twelve years and knew he was not indifferent to conditions outside the city. But his position depended on meeting requirements established by the Ministry of Territorial Protection. A failure to maintain the reserve could trigger an investigation and place the authority under direct administrative control.

No one at the table wanted that.

After the briefing, Mira returned to her office and examined the outer-catchment records. Most were several years old. They listed registered agricultural withdrawals and authorised residential use. Seasonal grazing demand was included only as an estimate.

One of the affected areas was Kharu.

Mira recognised the name. Her father had grown up in a village near there, before the original schools and health posts were closed. When she was a child, he sometimes took her to the upper valleys. She remembered narrow paths, stone houses and the taste of water from a spring beside the road.

She had not visited in more than thirty years.

The records showed that Kharu's seasonal water allocation had been reduced twice during the previous decade. The proposed directive would reduce it again.

Mira opened the historical usage data. The system displayed no significant permanent population, but there were repeated temporary withdrawals during spring and autumn.

She sent a request to the regional records office.

Please provide current seasonal population and livestock estimates for Kharu and the adjacent grazing areas. Required for assessment of proposed diversion.

An automated reply arrived immediately.

Population data for non-registered settlements are not maintained at municipal level.

She submitted the request again, this time to the regional water office.

By lunchtime, there was no response.

At home that evening, Anika was preparing a school presentation about the city's founding.

“Did people always live inside the protected boundary?” she asked.
“No. Most of the new districts were built after the first protection programme.”
“What happened to the people who lived outside?”
“Some moved here.”
“And the others?”
“They stayed where they were, or moved somewhere else.”

Anika looked at her notes. “Our teacher says Tashi survived because the government made difficult decisions.”
“That is partly true.”
“Which part?”

Mira put down the vegetables she had been cutting. “The city received investment that other places didn't. That made it easier to remain here.”

“Why didn't those places receive investment?”
“Some were difficult to protect. Some were considered too expensive.”
“And some?”
Mira looked at her daughter. “Some weren't given priority.”

Anika wrote something down.

The next morning, the regional water office replied. The message contained a table of authorised withdrawals but no updated population figures. A note stated that temporary settlements were expected to adjust their water use according to seasonal allocations.

Mira called the number attached to the report.

A man answered after several attempts. His name was Paldan, and he worked in the regional field office.

“I need to know how many people are using the catchment,” Mira said.
“We don't have a reliable count.”
“What about the grazing communities?”
“They aren't permanently registered.”
“Someone must have an estimate.”
“We have figures from the last permit cycle.”
“Those are six years old.”
“I know.”

She explained the proposed diversion.

Paldan was silent for a moment. “The upper communities have already received reduced deliveries this month.”
“Why?”
“Transport restrictions. Two vehicles lost their route authorisation.”

Mira thought of the water containers she sometimes saw waiting near the northern gate. She had never asked where they were going.

“Can you send me the delivery records?”
“They're not part of the water allocation file.”
“Send them anyway.”

He hesitated. “I can request permission.”

When the records arrived that afternoon, they showed that several deliveries had been delayed or cancelled during the previous three weeks. The quantities were small compared with Tashi's daily consumption. For households outside the protected area, they could be substantial.

Mira combined the figures with the proposed diversion and ran a new calculation.

The result troubled her. Under the authority's official model, the outer catchment retained enough water to meet registered demand. When estimated seasonal use and delayed

deliveries were included, several locations could fall below the basic allocation applied inside Tashi.

She checked the assumptions twice.

At five, she took the report to the director.

“The diversion is technically possible,” she said. “But the external impact assessment is incomplete.”

He read the summary.

“These are estimates.”
“Yes. Because nobody has collected current data.”
“We can't postpone the entire allocation decision.”
“I'm not asking you to postpone it indefinitely. I'm asking for a field assessment before implementation.”

He placed the report on the table.

“If we delay, the reserve falls below the required threshold.”
“For how long?”
“Possibly several weeks.”
“Then we should reduce discretionary consumption inside the city.”

He looked up. “You know what that means.”

She did. The ornamental gardens would receive less irrigation. The public cooling system in the commercial district would operate at reduced capacity. Several industrial users would have to postpone production.

There would be complaints. Some companies had contractual guarantees. The city administration had spent years assuring residents that basic services would remain unaffected by conditions beyond the boundary.

A voluntary reduction had been proposed before. It had not received enough support.

“The hospital and residential supply can remain protected,” Mira said. “We can meet the reserve target later without diverting the full amount now.”
“And the commercial district?”
“It would have to reduce its allocation.”

The director folded his hands. “Your responsibility is to assess the network, Mira. Not to rewrite regional policy.”
“The network includes the outer catchment.”
“Administratively, it does not.”

She looked at him for a moment.

“That is the problem.”

He returned the report.

“If you submit this as an official objection, it will be reviewed by the ministry. You know the procedure.”

Mira did know. An objection could delay implementation, but it would also trigger an examination of the assumptions used in the authority's reserve calculations. Her work would be scrutinised. The director's decisions would be questioned. The ministry might conclude that the water authority had failed to manage its responsibilities. The consequences could extend beyond one allocation decision.

She left the office with the report.

At home, Anika was waiting at the kitchen table. Her presentation was open on the wall screen, showing photographs of Tashi before the expansion.

“Can I ask you something?” she said.

Mira nodded.

“Were people allowed to move here when the city was built?”
“Some were.”
“Why not everyone?”
“There wasn't enough housing. There were rules about who could register.”
“Did those rules change?”
“Several times.”

Anika looked at the old photographs. “I think I'd have wanted to live here.”
“So would I.”
“But if everyone had wanted to come, what would they have done?”

Mira sat down beside her.

“I don't know.”

Anika turned towards her. “Is that why there are gates?”

“Partly.”

They spent the next hour working on the presentation. Anika chose a photograph of the original river channel, taken before the reservoirs and diversion structures were built.

It showed water running through a wide bed of stones. There were fields on both sides and a narrow bridge connecting the settlements.

Mira remembered standing on that bridge with her father.

He had told her that in spring the river sometimes rose so quickly that people could hear the stones moving beneath the water.

She had forgotten his words until that evening.

After Anika went to bed, Mira returned to her report.

The objection form was straightforward. It required a technical justification, an explanation of expected consequences and a declaration that the submitting officer accepted responsibility for the accuracy of the information.

Mira attached the alternative allocation model.

She included the delivery records and marked the population estimates as uncertain.

Then she added a recommendation: reduce non-essential municipal consumption until a current assessment of the outer catchment could be completed.

The system warned her that the submission would suspend implementation of the diversion pending review.

A second message informed her that the objection would be recorded under her professional authorisation.

She sat with her hand above the screen.

She thought about the hospital, the industrial district and the families who depended on reliable water. She also thought about the people outside the city, whose needs were absent from the official model because the system had stopped counting them.

She pressed *Submit*.

The next morning, the water came on at six as usual.

Mira filled the kettle and listened to the pipes settle behind the wall. Nothing in the apartment had changed. The lights worked, the garden sprinklers started and the first bus arrived at the stop below.

Her daughter appeared in the kitchen.

“Did you finish your report?”
“Yes.”
“Was it accepted?”
“I don't know yet.”

Anika poured herself some tea. “What happens if they don't accept it?”

Mira looked out across the city.

Beyond the last row of residential buildings, the protected boundary followed the curve of the valley. Farther away, the mountains rose into the morning haze.

“We'll have to decide what to do next,” she said.

At the office, an official notice was already waiting.

The diversion had been suspended for seven days. A field assessment had been ordered, and the municipal authority was instructed to provide revised consumption figures.

There was no indication that the ministry would accept her recommendation.

The director had also requested a meeting.

Mira read the notice twice. Then she opened the water network display and began calculating how much the city could save without reducing essential services.

For the first time in years, the model included the communities beyond the gates.

7.3 Two Places to Call Home

Figure 7.3. Asha and her family at a regional transport terminal, preparing to relocate under a negotiated mobility agreement, 2100.

Fictional future visualisation created for TEOS 2100.



The approval arrived on a Tuesday morning, just as Asha was repairing the roof.

She had been fastening a loose panel above the kitchen when her wrist device sounded. At first she ignored it. The wind had been strong during the night, and she wanted to finish before the afternoon rain. But the device signalled again, and she climbed down the ladder to read the message.

Her family's application for coordinated residence had been approved.

She read the notification twice. It listed four names: her own, her husband Milan, their daughter Leela and their younger son Ravi. Below the names were the conditions of admission, the period within which they could register in the receiving district, and a reference to the Himalayan Basin Mobility Agreement.

Asha sat on the lowest step of the ladder. They had submitted the application seven months earlier, and she had spent much of that time imagining how she would feel if it was accepted. Now that the approval had arrived, she felt surprisingly little. The house was quiet except for the wind moving through the walnut tree in the courtyard.

Her father appeared in the doorway.

“What's happened?”
“We have permission.”

He looked at the device in her hand. “For all of you?”
“Yes.”

He nodded slowly, as though she had told him that a distant road had reopened.

“When do you have to leave?”
“We don't have to. But we need to register within six months if we want to use the places.”

He sat beside her. “Then you have some time.”

Asha looked towards the fields below the house. The terraces followed the mountainside in irregular lines, their stone walls repaired so often that little remained of the original construction. Her family had cultivated the land for four generations. The fields were smaller now. Some had been abandoned after the irrigation channels became unreliable, and others were planted only when seasonal water forecasts allowed.

The house stood above a village in the upper Karnali region of Nepal. It was neither abandoned nor prosperous. Several families had moved away during the previous twenty years, while others continued farming with a combination of local work and income earned elsewhere. A small cooperative maintained the main water channels and organised the distribution of irrigation water during dry periods.

Asha worked for the cooperative as an agricultural technician. She monitored soil conditions, helped farmers plan irrigation and maintained the instruments used to measure available water. Her income was modest but dependable. Milan repaired agricultural machinery, mostly in nearby settlements.

They had managed to remain in the village longer than many of their friends. Yet during the previous three years, the cooperative had reduced the area receiving regular irrigation. Asha's technical reports showed that maintaining all the existing channels would require investment the community could not afford.

Her job had increasingly involved deciding which fields could receive water and which would have to wait.

The decision to apply for mobility had begun with Leela.

Two years earlier, the girl had asked why her school no longer offered the science programme she wanted to study. The teacher explained that the district could no longer maintain enough specialist staff for every subject. Some lessons were available remotely, but the connection failed frequently, and the practical equipment had been transferred to a larger school.

Leela was now thirteen. She wanted to study engineering, though she had recently developed an interest in medicine as well. She changed her mind often, which Asha regarded as a sign that she still believed she had choices.

The receiving district was located in northern India, near a transport corridor connecting several towns at the Himalayan foothills. Its authorities had agreed to accept families through the regional mobility programme in return for financial contributions to housing, schools and public services. The agreement recognised certain qualifications, established

procedures for transferring social protection entitlements and allowed participating households to maintain legal connections with their communities of origin.

Asha had been offered a position with an agricultural water-management service. The salary was higher than her current income, although housing costs would absorb much of the difference.

Milan's qualifications had been provisionally recognised. He would have to complete a short assessment before obtaining full permission to work on the district's automated equipment.

For Leela and Ravi, school places were available.

The documents were reassuring. They were also full of conditions.

That evening, Asha and Milan sat at the kitchen table with the approval open between them. The children were outside, helping their grandfather cover the vegetables before the rain.

“We could go at the beginning of the school year,” Milan said.
“That would be easiest for Leela.”
“And for Ravi.”

Asha nodded.

Milan enlarged the housing information. The apartment offered to them had three rooms, access to public transport and a guaranteed basic water allocation. The building was part of a receiving neighbourhood developed through the mobility agreement. Families from several countries lived there, alongside residents who had moved from other parts of India.

“The apartment is smaller than this house,” Milan said.
“It has reliable heating.”
“And no garden.”
“There are shared growing areas.”

He looked at her. “You know that's not the same.”

She did know. Their courtyard was where the children had learned to walk, where her mother had prepared food during festivals and where neighbours gathered when something needed repairing. The walnut tree had been planted before Asha was born. Every autumn, her father collected the nuts and insisted that the harvest was poorer than it had been in his childhood.

They had argued about leaving for months, but neither had spoken much about what the house meant to them.

Milan closed the housing file. “What about your father?”
“He says he wants to stay.”
“Then we can't all leave.”
“We could visit.”
“How often?”

Asha opened the travel arrangements. The agreement allowed participating residents to travel between the two countries and maintain certain rights while absent from the receiving district. Her father would also be eligible for a family residence application, though approval was not automatic.

“We could come back twice a year,” she said.
“And if the road closes? If he becomes ill?”

She had no answer.

The next morning, Asha walked with her father to the upper irrigation channel. The water was running slowly through the narrow stone-lined trench. He carried a wooden tool used to clear sediment, although the cooperative now had equipment capable of doing the work in a fraction of the time.

He preferred the wooden tool.

“Do you think the channel will still work when Ravi is my age?” he asked.
“I don't know.”
“You usually know these things.”
“I know what the measurements say.”
“And what do they say?”
“That we can maintain part of the system. Not all of it.”

He scraped a small accumulation of gravel from the channel.

“When I was young, we worried about losing fields to floods. Now we worry about having enough water to plant them.”

Asha watched him work. She had heard the comparison many times, though it was not entirely accurate. Floods remained a danger, and water scarcity had existed long before her birth. What had changed was the uncertainty surrounding the seasons and the cost of maintaining the infrastructure on which farming depended.

“I don't want you to think we're leaving because the village has failed,” she said.

He rested the tool against the wall.

“Why would I think that?”
“Because you stayed. Because you helped build the new channels. Because we told everyone we could make this work.”
He looked down the valley. “You have made it work. For a long time.”
“Not for much longer.”
“Perhaps not for the whole village.”

She turned towards him.

“I am not coming with you,” he said. “But I don't need you to stay here for my sake.”

That afternoon, Leela returned from school carrying a collection of handwritten notes. She had been working on a project about the history of the village and had interviewed several older residents.

“Grandfather says we might move,” she said.
“We're thinking about it.”
“Do we have to?”
“No.”
“Then why are we going?”

Asha sat beside her. “Because the new district has schools and work that might be better for us.”
“There's a school here.”
“I know.”
“And you have work.”
“Yes.”

Leela looked at the notes in her lap. “Then it's not because we have nowhere to live.”
“No,” Asha said. “It isn't.”

The girl considered this.

“If we move, can I still come back?”
“Of course.”
“Not just for holidays. Could I live here again?”

Asha had read the agreement carefully, but the question made her hesitate. Their right to return to Nepal was not in doubt. The more difficult question concerned the house, the land and their place within the cooperative if they no longer lived there permanently.

“I think so,” she said. “But we need to find out what happens to our land rights.”

Leela frowned. “Why would those change?”
“Because some of the water and grazing rights depend on living here.”
“That doesn't seem fair.”
“Other families need those resources too.”
“But it's still our home.”

Asha did not disagree.

The following week, she attended a meeting of the village cooperative. Several households had received mobility approvals, and the committee was considering changes to its membership rules. Families moving away wanted to retain their property and the right to return. Those remaining argued that limited irrigation water should not be allocated to fields that were no longer cultivated.

The discussion lasted nearly three hours.

One farmer suggested that absent households should lose all water-use rights after two years. Another argued that this would discourage people from returning and make it harder to maintain the village population.

Asha proposed a temporary arrangement. Households participating in the mobility programme could retain ownership and cooperative membership, but their irrigation allocations would be reduced while their fields were not in use. They could reactivate those allocations when they resumed cultivation, subject to the resources available at the time.

Several members supported the proposal. Others wanted stricter conditions.

The committee agreed to test the arrangement for five years.

Asha left the meeting relieved, though she knew the decision would not resolve every dispute. Some families owned more land than others. Some had relatives able to maintain their fields. Others would have to leave property unused.

The mobility agreement offered new opportunities, but it also required the village to reconsider what it meant to belong to a place.

A month later, Asha travelled to the receiving district alone. The journey took most of a day. She crossed the border using her provisional mobility authorisation, presented her qualifications at the district office and visited the water-management service where she would work.

The office was housed in a low building overlooking a reservoir. The director, a woman named Kavita, showed her the monitoring systems and explained the district's water allocation procedures.

“We have a growing population,” Kavita said. “Not just through this programme. People come here from other districts as well.”
“Do residents accept the new arrivals?”
“Some do. Others think the agreements were made without asking them.”
“What does the municipality do about that?”
“We hold consultations. We publish the figures. We argue about the budget.”

Asha smiled.

“That sounds familiar.”

Kavita led her onto a terrace overlooking the water.

“Most people here understand why the programme exists,” she said. “But understanding doesn't mean they are happy when the school is full or the waiting time at the clinic increases.”
“Does the regional fund cover those costs?”
“Part of them. The rest is negotiated every year.”

Asha looked towards the residential buildings on the opposite hillside. They were arranged around courtyards, with shaded walkways and shared gardens. Children were returning from school, and a group of older residents sat beneath a row of trees.

The place was unfamiliar, but it did not look temporary.

She visited the apartment that afternoon. It was on the fourth floor, overlooking a public garden. The rooms were smaller than she had expected, and the kitchen had little storage space. But there was light, and the water ran when she turned the tap.

On the wall near the entrance was a small display showing the household's basic service entitlement. Asha examined it, then turned it off. She had spent enough years monitoring water to know that a reliable allocation was valuable. She did not want to begin every morning by checking a screen.

Before leaving, she walked to the local school. The admissions officer confirmed that Leela's educational record had been received and her completed subjects recognised. Ravi would enter a class with children of similar ages.

There were language-support lessons for those who needed them, and the school had a programme through which students could maintain contact with educational institutions in their places of origin.

Asha thought of Leela's questions about returning.

The agreement made movement possible. It did not determine where her daughter would eventually feel at home.

When Asha returned to the village, the walnut tree had begun to lose its leaves. Milan was repairing a pump in the courtyard, and the children were helping their grandfather sort the remaining harvest.

“How was it?” Milan asked.
“Smaller than here.”
“The apartment?”
“Everything.”

He laughed.

“But the school is good,” she continued. “The job is real. And the district seems prepared for people to arrive.”
“Do you want to go?”

Asha looked towards her father, who was sitting beside the children. He raised his hand in greeting.

“I think we should try,” she said.

They decided to move at the beginning of the next school year. Milan would complete his professional assessment, and Asha would begin work at the water-management service. The children would enrol in their new schools.

Her father would remain in the village. The family would return whenever possible, and the cooperative would maintain their membership under the temporary arrangement.

They did not sell the house.

During the following weeks, Asha sorted through cupboards and packed the belongings they could take. She discovered photographs she had not seen in years, old school certificates and a small box containing her mother's jewellery.

Leela insisted on bringing her notebooks about the village. Ravi wanted to take a wooden model of a waterwheel that his grandfather had made.

Milan packed his tools.

On the morning of their departure, Asha walked alone to the upper irrigation channel. The water was low but still moving. She checked the measuring instrument out of habit and recorded the reading in the cooperative's register.

Then she removed her name from the list of technicians responsible for the following month.

Someone else would take the measurements.

When she returned to the house, her father was waiting by the gate. He handed her a cloth bag containing walnuts from the last harvest.

“For the children,” he said.
“We'll come back.”
“I know.”

She embraced him, then climbed into the vehicle beside Milan. Leela sat behind them with her notebooks on her lap. Ravi had fallen asleep before they reached the main road.

As the village disappeared around a bend, Asha opened the mobility agreement one last time. Their residence rights were valid, their school places confirmed and their social protection records recognised.

There was nothing more to approve.

She closed the document and looked out of the window.

The road followed the river downstream. Somewhere beyond the mountains, another home was waiting for them. She did not yet know what it would feel like to live there.

For the first time, she realised that the agreement had not required them to choose between two countries.

They had made a different decision.

They would try to belong to both.

7.4 The Receiving City

Figure 7.4. Farid Rahimi, a municipal administrator with family roots in the Wakhan region of the Hindu Kush, responsible for implementing regional mobility agreements in Dharvan, 2100.

Fictional future visualisation created for TEOS 2100.



Farid Rahimi had been awake since five, although the meeting was not until nine. He had spent the previous evening reviewing a housing allocation that would leave twelve families without the apartments they had been promised. The problem was not that the families lacked permission to settle in Dharvan. Their residence rights had been confirmed months earlier. The problem was that the apartments were not ready.

At seven, he received a message from the district construction office. The eastern housing complex would require another six weeks before it could be occupied. A fault had been discovered in the wastewater system, and the contractor refused to certify the building until the repairs were completed.

Farid read the message while standing in his kitchen. He was fifty-two, with dark hair turning grey at the temples and a closely trimmed beard. He wore glasses when reading, though he frequently forgot where he had placed them. This morning they were on the table beside a half-finished cup of tea.

His wife, Laila, entered carrying the morning bread.

“Another delay?”
“Six weeks.”
“That's not so bad.”
“Twelve families arrive next Monday.”

She looked at him. “Ah.”

Farid closed the message. He had learned that delays were rarely measured in days or weeks alone. For a family preparing to move, six weeks could mean losing temporary accommodation, postponing employment or taking children out of school. The administrative calendar and the household calendar seldom matched.

Dharvan was a medium-sized city in northern India, built along a transport corridor between the Himalayan foothills and the agricultural plains. Its population had grown steadily during the second half of the century. Some people had arrived from environmentally exposed mountain communities. Others moved for work or education, and many had come through the regional mobility agreements established between participating countries.

The agreements provided recognised procedures for residence, employment and access to essential services. They also required receiving districts to plan for incoming populations and report their housing and infrastructure capacity.

Farid had helped establish the municipal office responsible for these arrangements. Before that, he had worked in the education department, where he had seen children lose months of schooling because records from their previous districts were incomplete or unrecognised. The new agreements had reduced many of those difficulties. They had also created responsibilities that were easier to describe in legal documents than to fulfil in practice.

At the office, his deputy, Arjun, was already waiting.

“The housing department has offered temporary accommodation,” he said.
“Where?”
“The old municipal training centre.”

Farid frowned. “That building has one kitchen for forty rooms.”
“Thirty-eight.”
“And the water supply?”
“Limited to the west wing.”

He placed his bag on the desk. “Then it's not suitable for twelve families.”

Arjun opened a second file. “The district finance office says we have exhausted the emergency accommodation allocation.”

“We haven't exhausted it. The transfer hasn't arrived.”
“According to their records, it's been approved.”
“Approved isn't paid.”

Arjun nodded. They had worked together long enough to recognise the difference.

The regional mobility programme was financed through contributions from participating states and transfers to receiving municipalities. In principle, additional residents were accompanied by funding for housing, schools and healthcare. In practice, transfers often arrived after the expenses they were intended to cover.

The city had accepted its annual allocation of incoming households on the understanding that the eastern housing complex would open before the school year. Construction delays had changed that calculation. The school places were still available, and employers were waiting for workers who had accepted contracts. Only the housing was missing.

Farid opened the list of arriving families. Some came from Nepal, others from mountain districts farther west. One household had an elderly parent requiring regular medical treatment. Another included three children, the youngest only four.

He stopped at the name of a family from the upper Karnali region. The mother was an agricultural technician who had accepted a position with the district water-management service. Her qualifications had been recognised, the children's school enrolments confirmed and the father's professional assessment scheduled.

Everything had been arranged except a place to live.

Farid closed the file.

“Find out how many apartments are temporarily vacant in the western district,” he told Arjun. “And call the housing cooperative. I want to know whether any renovation units can be completed early.”
“We've already asked.”
“Ask again. But don't promise anything.”

At nine, the municipal council's infrastructure committee assembled in the conference room. Representatives from the housing department, the education service, the water authority and the district finance office sat around a long table. Two elected councillors joined remotely from neighbouring districts.

The committee had been established years earlier to coordinate the practical effects of mobility agreements. It had authority to recommend spending adjustments, but changes above a specified amount required approval from the municipal council.

Farid presented the housing delay.

“We have twelve households due to arrive,” he said. “Their residence rights and service entitlements are valid. We are responsible for providing the accommodation included in the district agreement.”

Councillor Bedi leaned forward.

“Why should the municipality pay for a contractor's failure?”
“We can pursue the contractor separately.”
“That doesn't answer my question.”
“The families cannot sleep in a legal claim.”

Several people looked down at their screens.

Bedi continued. “Residents have been waiting for affordable housing for years. Every time another group arrives, we're told their places are already guaranteed.”

Farid understood the frustration. The waiting list for municipal housing included more than three hundred local households. Some had applied years earlier. The mobility agreements had increased housing investment, but much of the new construction was tied to specific funding conditions.

“It isn't a choice between providing housing for newcomers and providing housing for established residents,” he said. “We have obligations to both.”

“Then why are the newcomers being offered new apartments?”
“Because the regional agreement financed those apartments.”
“And the local families?”
“They are entitled to the housing programme financed through the municipal budget.”

Bedi spread his hands. “You see the problem.”

Farid did. Separate budgets did not create separate housing markets. Residents saw buildings being completed and wanted to know why they could not apply. The legal explanation was straightforward, but it did not make the distribution feel fair.

The committee asked for alternatives. The finance officer proposed postponing maintenance at two public buildings to cover temporary accommodation. The education representative warned that one of those buildings was a school whose ventilation system had already failed twice during the summer.

Farid rejected the proposal.

“We cannot solve one service problem by creating another.”

The water authority offered unused administrative rooms at a treatment facility. They were suitable for short visits but not for families with children. A private landlord offered apartments at rates far above the municipal limit.

By the end of the meeting, no acceptable solution had been found.

During lunch, Farid walked to the small garden behind the administration building. His mother used to meet him there when she worked nearby, bringing food wrapped in cloth and insisting that he ate something before returning to work.

His mother had died eleven years earlier. She had spent most of her adult life in Dharvan, though she never stopped speaking about the Wakhan valley where she was born. Her family had moved during a period of political instability, long before the regional mobility agreements existed.

They had travelled through several countries before obtaining secure residence. Farid grew up hearing stories of waiting rooms, rejected documents and strangers who had helped his parents when official arrangements failed.

His mother rarely described the journey as an adventure. She spoke instead about ordinary things: finding a school for her children, getting medicine for Farid's younger sister and learning which office could issue a residence certificate.

When Farid was fourteen, he had asked why his mother still kept their old travel documents.

“Because we needed every one of them,” she replied.

Farid had remembered the answer throughout his career. The new mobility system was intended to prevent families from depending on luck or personal favours. Yet today he was searching for a favour from a housing cooperative.

His device sounded.

Arjun had found four available apartments in the western district. Two required minor repairs, but the cooperative believed they could be ready within a week.

Farid called him.

“Four isn't twelve.”
“No. But it's four.”
“What about the others?”
“The housing cooperative wants to discuss a temporary arrangement.”

He returned to the office.

The cooperative's director, Meera Sethi, was waiting on the screen. She explained that several apartments were occupied by elderly residents who had applied to move into smaller units. Their transfers had been delayed because the new building for older residents was awaiting final inspection.

“If we accelerate those transfers,” Meera said, “we could release another six apartments.”
“Are the residents willing to move?”
“Most of them have been asking when they can.”
“And the remaining two?”
“We could offer short-term accommodation in the guest units. But we'd need additional funding.”

Farid examined the figures. The costs were higher than expected but lower than renting from private landlords.

“Can you prepare a formal proposal?”
“By tomorrow.”
“Include the residents' consent. I don't want anyone moved simply because we need their apartment.”

Meera agreed.

Farid spent the next hour drafting a request for an emergency transfer from the regional mobility fund. He included the construction delay, the alternative housing proposal and the consequences of postponing the families' arrival.

Then he added a paragraph that made Arjun look up from his desk.

“You're asking them to change the payment schedule?”
“Yes.”
“They've refused that before.”
“Then they can explain why a municipality must finance their commitments months before receiving the money.”

Arjun smiled. “That will make the meeting interesting.”
“It already is.”

The following morning, Farid attended a consultation with residents from the western district. News of the proposed housing transfers had spread, and several community representatives wanted assurances that existing tenants would not be displaced.

The meeting took place in a school hall. Around sixty people attended, including residents, teachers and members of the local housing cooperative.

A woman in her seventies stood up first.

“I've lived here for forty-two years,” she said. “I've been waiting for a smaller apartment for three. Now I'm told I might be moved next week.”
“Only if you agree,” Farid replied.
“Why wasn't it possible before?”
“Because the building you applied to wasn't ready.”
“And now it is?”
“It has passed the final inspection.”

The woman folded her arms. “Then I want to see it before I decide.”
“Of course.”

Another resident asked why the municipality continued accepting new families when local services were already under pressure.

Farid explained the regional agreement and the funding arrangements. He described the additional water-management staff, teachers and healthcare workers who had arrived through the programme in previous years.

A man near the back raised his hand.

“I'm a teacher,” he said. “My school has received children through these agreements. Some of their parents work in the hospital. Others repair the transport system. I don't object to them coming. But we're still waiting for the additional classrooms we were promised.”

Farid nodded. “You're right.”
“Then why should we believe the next promises?”

He paused. The question deserved more than a rehearsed explanation.

“You shouldn't have to rely on promises,” he said. “You should be able to see what has been funded, what has been completed and what is delayed. Our reports haven't made that clear enough.”

The room was quiet.

“We'll publish the housing and service allocations together,” he continued. “That includes the commitments to existing residents and those arriving through the agreements.”

Some people nodded. Others remained unconvinced.

Farid did not expect the meeting to resolve the tension. He wanted residents to understand the choices being made and to have a way to challenge them.

On Friday, the regional authority approved part of the emergency funding request. It authorised an advance payment covering temporary accommodation and required the municipality to submit a revised construction schedule.

The contractor agreed to cover a portion of the additional costs, though the legal details remained unresolved.

By Monday morning, the cooperative had prepared ten apartments. Two families would spend the first weeks in temporary guest accommodation before moving into permanent housing.

The arrangements were imperfect, but every arriving family had an address and access to essential services.

Farid reviewed the final list before authorising the housing assignments.

He noticed that the family from upper Karnali had been allocated an apartment near the district school. The agricultural technician would be able to reach her workplace by public transport.

Farid did not know the woman. Their names had appeared together on a series of administrative documents, but they had never spoken.

He signed the assignment.

At midday, he travelled to the regional transport terminal to meet representatives from the housing cooperative. The terminal was crowded with arriving passengers, many carrying small bags and folders containing documents. The admissions desks were busy, but people moved through them without the long delays Farid remembered from his mother's stories.

He watched a family of four emerge from the registration area. The mother carried a cloth bag, while the father tried to manage two cases and a sleeping child. Their teenage daughter was reading information on a wall display.

For a moment, Farid thought of his own family arriving in Dharvan decades earlier.

The circumstances were different. These people had recognised rights, employment arrangements and access to public services. They would not have to depend on strangers to explain where they could live.

Yet they still looked uncertain.

One of the housing officers approached the family and introduced himself. He offered to show them the transport connection to their apartment.

The mother asked a question, and the officer pointed towards the municipal service centre.

Farid could not hear what they were saying.

He wondered whether they were discussing water allocations, school registration or something entirely unrelated to the move. Perhaps they simply wanted to know where to buy food.

A message arrived from the regional finance office.

The next quarterly transfer would be reviewed following an assessment of municipal expenditure. No date was provided.

Farid read the message, then turned back towards the terminal.

He knew there would be another budget meeting, another delay and another argument about who should pay for the obligations governments had agreed to undertake. Some residents would remain dissatisfied. Some families would find that the opportunities they had expected were harder to obtain than the agreement suggested.

The work would continue.

As he prepared to leave, a young man approached him.

“Excuse me,” he said. “Are you from the municipality?”
“Yes.”
“My mother arrived yesterday. Her healthcare record hasn't transferred. They say we need confirmation from the previous district.”

Farid took out his device.

“Do you have the reference number?”

The young man showed it to him.

Farid recognised the type of problem. The agreement covered the transfer of records, but the two administrative systems used different verification procedures. It could usually be resolved with a manual request.

“Come with me,” he said. “There's an office just across the hall.”

As they walked, the young man explained that his mother needed medication before the end of the week.

Farid listened, then called the district health coordinator.

He could not make the problem disappear, but he knew who had the authority to resolve it.

At the service counter, he introduced the young man to the coordinator and confirmed that the request would be treated as urgent.

When he returned to the terminal entrance, the afternoon light was falling across the mountains beyond the city.

He thought about the agreements signed in distant capitals, the figures presented in regional reports and the legal rights that appeared so clear on paper.

They mattered. Without them, many of the people arriving that day would have had far fewer options.

But the agreements became real only when someone could enter a home, enrol a child in school or obtain the medicine they needed.

Farid looked at the line of passengers moving towards the registration desks. Then he checked the time and returned to his office.

There was another housing meeting at four.

7.5 The Network Goes Dark

Figure 7.5. Amara Okonkwo and fellow mobile professionals at a mountain connectivity hub in the Networked Nomads scenario, 2100.

Fictional future visualisation created for TEOS 2100.



The first thing Amara noticed was that the payment had not arrived.

She was standing in the small kitchen of her rented apartment, waiting for the water to boil, when she opened the account on her wrist device. The balance was unchanged. A payment for the maintenance work she had completed two days earlier was still marked as pending.

She checked the transaction history. The assignment had been approved, the client had confirmed completion, and the platform had issued a payment reference. Everything appeared normal except the absence of money.

Amara tried to refresh the account. The screen remained blank for several seconds before displaying a message.

Network services temporarily unavailable.

She frowned. The network had been unstable during the night, but the building's local connection was working. She could see the municipal weather forecast, exchange messages and access the control system for the apartment's energy supply.

Only the professional platform appeared to be affected.

Her kettle switched off.

Amara was thirty-six and had lived in Kathmandu for almost three years, longer than she had stayed anywhere since leaving Lagos. She had come to Nepal to supervise the installation

of distributed energy systems in mountain settlements and had remained because the work was interesting and the contracts paid well.

Her clients were spread across several countries. Some operated solar microgrids, others maintained communication equipment or supplied energy storage systems to remote communities. She rarely met the people who approved her assignments.

Most of her professional life existed within a network called Meridian.

The platform maintained her qualifications, employment history, client evaluations and technical authorisations. It arranged payments in different currencies and provided the insurance required for work at remote installations. Its scheduling system allowed her to accept assignments across several jurisdictions without negotiating separate contracts for every project.

Amara had once described the arrangement to her older brother as the closest thing she had found to professional freedom.

She could refuse assignments. She could move between countries where she had the necessary residence and work permissions. She could take several weeks off and visit her family in Nigeria without asking an employer for leave.

Her brother had asked what happened if the platform stopped working.

She had laughed.

Now she remembered the question.

At eight, a message arrived from her current client, a regional energy cooperative responsible for a group of settlements northeast of the city.

Urgent maintenance request. Storage control failure reported at the Khelung facility. Assignment available through Meridian.

Amara opened the platform. The request appeared briefly, then disappeared.

She tried again. The account would not load.

She called the cooperative's operations manager, Sajan.

“Did you send the assignment?”
“Yes. You're the nearest certified engineer.”
“I can't accept it. Meridian is down.”
“I know. We have the same problem.”
“What's happening at Khelung?”
“The storage units are running, but the control system isn't distributing power correctly. The local technician has switched to manual operation.”
“How long can they manage?”
“Until the batteries reach their lower reserve.”
“And then?”
“Essential services only. Perhaps not even those, depending on demand.”

Amara opened the technical map on her desk display. Khelung was a small mountain settlement with a workshop, a school and a health post. Its energy system combined solar generation, storage and a connection to a larger regional network. The settlement could operate independently when the external supply was interrupted, but only if its local controllers allocated electricity correctly.

She had worked on a similar installation the previous year.

“Send me the diagnostic files,” she said.
“I can't. They're stored in the Meridian workspace.”
“Don't you have local copies?”
“The maintenance company does. Their server is connected through Meridian.”

Amara looked at the map.

“Call the technician. Ask him to photograph the controller readings and send them directly.”
“Will you take the job?”
“I need to see what's wrong first.”
“Can you travel?”
“Yes.”

Sajan hesitated. “We may not be able to issue a valid assignment until the network returns.”
“I understand.”

He did not have to explain what that meant.

Without an authorised assignment, Amara's professional insurance might not cover the work. The cooperative could also have difficulty paying her, and any intervention she made might fall outside the maintenance contract.

She could inspect the system informally, but replacing components or modifying its software would expose her to significant liability.

The distinction was not new. What troubled her was how little room it left for an actual emergency.

She dressed, packed her diagnostic equipment and left the apartment.

The street outside was busy. Delivery vehicles moved between the buildings, and the market stalls were opening beneath awnings that provided shade during the warmer months. Amara stopped at a bakery and bought two flatbreads.

Her phone rang while she was paying.

It was her mother in Lagos.

“Are you travelling again?”
“Only for the day, I hope.”
“You said that last time.”
“Last time the road closed.”

Her mother laughed. “And this time?”
“A computer problem.”
“Then perhaps you should stay home.”

Amara smiled. Her mother had never understood why a person trained to work with electrical equipment needed to travel through mountains to repair it.

“How is Uncle Chidi?” she asked.
“Better. The clinic adjusted his medication. Your brother is taking him back tomorrow.”
“Good.”

There was a pause.

“Did the money arrive?” her mother asked.

Amara looked at the payment notice.

“Not yet. There's a network problem.”
“Again?”
“It's the first serious one this year.”
“You always say that.”

Her mother was right about one thing. Amara's income was good, but its reliability depended on institutions her family rarely saw.

She transferred money home regularly to help cover her uncle's care. Her brother contributed as well, but his own business had experienced difficulties, and her payments had become increasingly important.

“I'll call you tonight,” she said.
“Please do. And eat something.”

Amara put the bread in her bag and continued towards the transport station.

The journey to Khelung took nearly three hours. A regional vehicle carried her along the main road, then a smaller electric shuttle followed a narrow route into the mountains. The landscape changed gradually from dense urban development to terraced fields, scattered settlements and exposed slopes.

Amara spent much of the journey examining the photographs sent by the local technician.

The controller display showed inconsistent readings from two storage modules. One appeared to be fully charged while another reported a state of charge well below the expected level. The automatic distribution system had responded by restricting power to several buildings.

The fault could be a damaged sensor, a communication problem or an error in the control software.

Normally, Amara would have accessed the manufacturer's diagnostic system through Meridian. The platform held her certification and provided the temporary access credentials needed to modify the controller.

Without it, she could inspect the equipment but might not be able to complete the repair.

When she reached Khelung, Sajan was waiting outside the energy building.

“Any change?” she asked.
“Two more buildings have lost normal supply.”
“Which ones?”
“The workshop and the community hall.”
“What about the health post?”
“Still operating.”

They entered the control room. A young technician named Ramesh stood beside the main cabinet. He looked exhausted.

“I've kept the essential circuits running,” he said. “But the controller keeps trying to reconnect the faulty modules.”

Amara set her bag on the table and examined the system.

“Have you isolated the communication link?”
“Yes.”
“And the modules?”
“I haven't disconnected them. The automatic system would treat that as a critical failure.”
“That's what it already thinks has happened.”

Ramesh gave a tired smile.

They worked through the measurements together. After twenty minutes, Amara identified a fault in the communication board serving one of the storage units. The battery itself appeared to be functioning correctly, but the controller was receiving incomplete information.

The repair was straightforward in principle. The board could be bypassed temporarily while a replacement was ordered.

The problem was authorisation.

Amara opened her professional account again. The platform displayed the same error.

Network services temporarily unavailable.

She tried the emergency technical access channel. It also failed.

Ramesh watched her.

“Can you change the configuration?”
“I can.”
“Then what's stopping you?”

“The controller requires a certified intervention record. Without it, the manufacturer can refuse responsibility for the system.”
“Are you certified?”
“Yes.”
“Then what is the problem?”

Amara looked at him.

“The record that says I'm certified is somewhere we can't reach.”

Ramesh considered this.

“That seems badly designed.”
“It is.”

Outside, a group of residents had gathered near the energy building. Sajan went to speak with them while Amara and Ramesh continued testing the equipment.

A woman arrived from the health post. She introduced herself as Dr Pema.

“We've been told the electricity may be reduced again,” she said.
“It might,” Amara replied.
“We have two patients who need continuous monitoring. We can use the emergency batteries, but they're old.”
“How long will they last?”
“Perhaps six hours. We haven't tested them under full load recently.”

Amara asked Ramesh to check the dedicated supply circuit.

The health post had priority within the local energy system, but the faulty controller could still interrupt supply if the storage reserve fell too low. The backup equipment provided another layer of protection, though its capacity was uncertain.

“Can you repair it today?” Pema asked.
“I think so.”
“Then please do.”

Amara did not answer immediately.

She could make the temporary configuration change without the manufacturer's credentials. The controller was an older model, and she knew how to access its maintenance interface locally. But doing so would bypass the system's normal audit procedure.

If the repair caused damage, she could be personally responsible.

If the system later failed, the platform might treat her intervention as unauthorised work. That could affect her professional rating or her ability to obtain future assignments.

She had spent fourteen years building her reputation. Losing it would mean much more than losing a single payment.

She looked at the health post through the control room window.

“Give me ten minutes,” she said.

Amara called the regional engineering office. The first person she reached told her that technical authorisation was handled through registered maintenance providers.

“Meridian is unavailable,” she explained.
“Then the provider should use its emergency procedure.”
“The emergency procedure also depends on Meridian.”

There was a pause.

“Can you submit a manual request?”
“Yes.”
“Then do that.”
“How long will approval take?”
“I can't say.”

She ended the call.

The situation reminded her of an argument she had once had with a client in Singapore. He had described digital verification as a way of eliminating unnecessary bureaucracy.

Amara had replied that the bureaucracy had not disappeared. It had simply become harder to see.

She opened a local recording programme on her diagnostic device and began documenting the controller readings. She photographed the serial numbers, recorded the condition of the communication board and asked Ramesh to confirm the measurements.

Then she prepared a temporary repair plan.

“I need two witnesses,” she told him. “And I need the cooperative to authorise the intervention locally.”
“Will that be recognised?”
“I don't know. But we'll have a record of what we did.”

Sajan returned from outside.

“The residents are asking whether they should shut down the workshop completely.”
“Not yet,” Amara said. “I think we can restore normal distribution.”
She explained the fault and the risks of proceeding without platform authorisation.

Sajan listened carefully.

“If we wait, the storage reserve may fall below the safe operating threshold,” he said.
“Yes.”
“If we proceed, there may be consequences for the maintenance contract.”
“Yes.”

He looked towards Ramesh.

“What do you recommend?”

Amara had expected him to ask whether the repair was technically possible. Instead, he was asking her to make a decision that would affect the cooperative, the manufacturer and her own professional position.

“I recommend a temporary bypass,” she said. “But only after we isolate the damaged communication board and record the intervention. The configuration can be reversed when the authorised system is available again.”

Sajan nodded.

“I'll sign for the cooperative.”

They began work shortly after two.

Ramesh isolated the affected equipment while Amara prepared the replacement connections. She checked each measurement before modifying the controller. The system initially rejected the change because it could not verify her credentials through the network.

She entered the local maintenance procedure and recorded the reason for the intervention.

Emergency operation. External verification unavailable. Local authorisation attached.

The controller accepted the configuration.

For several seconds, nothing happened. Then the distribution display began updating. The affected buildings reappeared, and the storage modules reported consistent readings.

Ramesh leaned forward.

“It's working.”
“Wait.”

Amara monitored the system for another twenty minutes. The voltage remained stable, and the reserve calculation returned to its expected range.

She called Pema at the health post.

“Your supply should be stable now.”
“Thank you.”
“Keep the emergency batteries charged. We still need to test the system properly when the network returns.”

After the call, Amara sat down.

She was relieved, but she also knew that the problem was not finished.

The network returned shortly before five.

Her account opened immediately. Messages began arriving in rapid succession: delayed payments, new assignments, maintenance notifications and a warning concerning the intervention at Khelung.

She opened the warning.

Unverified technical modification detected. Professional access subject to review.

A second message followed.

Assignment activity suspended pending investigation.

Amara read it twice.

Her professional account remained visible, but she could no longer accept new work.

The platform had recorded the intervention automatically. It had not accepted the local authorisation as sufficient.

Sajan came to stand beside her.

“Is there a problem?”
“They've suspended my assignment access.”
“Because you repaired the system?”
“Because I repaired it without their verification.”
“We'll send a statement.”
“Please do.”

She showed him the warning.

The cooperative's contract allowed emergency intervention under certain conditions, but the platform's rules required technical changes to be verified through its own procedures. The two arrangements did not align.

Sajan shook his head.

“I'll contact the manufacturer.”

Amara packed her equipment.

“Send me the signed intervention record first. I may need it.”

On the journey back to Kathmandu, she watched the evening lights appear across the valley. The small settlements below the road were connected by energy and communication networks that made work and public services possible in places where maintaining infrastructure had become increasingly difficult.

She had helped build some of those systems.

Now the same networks had excluded her from her own profession, at least temporarily.

Her mother called as the shuttle approached the city.

“Did you fix the computer?”
“The electricity is working again.”
“That wasn't my question.”

Amara laughed, then told her what had happened.

Her mother listened without interrupting.

“Can you still work?” she asked.
“Not until they review the account.”
“How long?”
“I don't know.”
“And the payment?”
“Still pending.”

Her mother was quiet.

“Your brother can cover the clinic this month,” she said.
“He shouldn't have to.”
“He said he can.”

Amara looked out of the window. She had chosen this way of working because it allowed her to earn a living without belonging permanently to one employer or one country. She had accepted the uncertainty of contracts and travel because the freedom had seemed worth it.

She had not expected her professional identity to depend so completely on the availability and decisions of a single platform.

When she reached her apartment, a message from Meridian was waiting.

The review would take up to ten working days. During that period, her professional account would remain restricted.

She could submit evidence, but the procedure was automated and provided no opportunity for a live hearing at the initial stage.

Amara uploaded the measurements, the cooperative's authorisation and the record of the repair.

Then she opened a message from Sajan.

The health post confirms stable power. The cooperative has submitted its statement. Thank you for coming.

She read it once, then put the device on the table.

Outside, the lights of Kathmandu stretched across the valley. Somewhere in the mountains, a school would open the next morning, a workshop would resume production and the health post would continue treating its patients.

Amara had helped make that possible.

Whether she would be permitted to work again was now a decision for people, or perhaps software, she had never met.

7.6 The Care-Bound Adult

Figure 7.6. Nasrin Chowdhury caring for her father at home while her daughter Samira attends remote school in Dhaka, Networked Nomads scenario, 2100.

Fictional future visualisation created for TEOS 2100.



Nasrin woke at five because electricity was cheaper before nine. She had learned to organise the household around those four hours. The washing machine ran first, followed by the water heater. While the batteries charged, she prepared porridge, checked the medical supplies and laid out her father's clothes for the day.

Her husband, Asher, was leaving for another maintenance assignment. He had packed his tools the previous evening and was standing in the kitchen, trying to repair the fastening on an old travel case.

“You could buy a new one,” Nasrin said.
“This one still works.”
“It has been falling apart for three years.”
“Then it has another three left.”

She smiled and put his breakfast on the table.

Asher repaired electrical and medical equipment for a network of private service providers operating across Bangladesh and neighbouring countries. His assignments usually lasted between ten days and three weeks. Sometimes he returned sooner. Occasionally he was away for a month.

They had met decades earlier at a medical camp outside Dhaka. Nasrin was working as a phlebotomist, collecting blood samples for diagnostic testing. Asher had come to repair a refrigeration unit that kept the samples at the required temperature. He stayed an extra day

because the replacement part arrived late. They had spent the evening talking beside the clinic while rain struck the temporary roof.

For years, their occupations had allowed them to travel together. Nasrin moved between regional clinics, and Asher often found work along the same routes. Their daughter, Samira, was born during one of the longer periods they spent near Dhaka.

Now Samira was twelve, Asher continued travelling and Nasrin had barely left their district in eighteen months.

Her father, Abdul, was the reason.

He was eighty-six and had lived independently until his memory began to fail. At first, he forgot appointments and misplaced household objects. Later, he became confused about where he was. Once, he left his apartment in the middle of the night and was found walking beside the old transport road, searching for a market that had closed thirty years earlier.

The doctor diagnosed a progressive form of dementia. Treatment helped with some symptoms, but Abdul increasingly required supervision. He could still dress himself on good days and sometimes remembered stories from his childhood in extraordinary detail. On other mornings, he did not recognise the room in which he had slept.

Nasrin had taken temporary family-care leave from her medical network. When the leave ended, she asked to return on reduced hours at a clinic near home.

The network offered her two options: resume travelling with a mobile diagnostic team or accept occasional assignments whenever local demand became available.

She chose the second.

During the following months, she received only four assignments. None provided enough income to maintain her employment-linked insurance. Eventually, the platform classified her as inactive.

She remained qualified to work as a phlebotomist. Her professional record was still accessible, and the training she had completed was recognised by several providers.

But recognition did not produce a salary.

At six, Asher transferred money to their household account. Nasrin checked the amount.

“That's less than last time.”
“The client has changed the payment schedule.”
“Have they paid you for the previous assignment?”
“Part of it.”

She knew he was worried. His work had become more irregular as maintenance companies competed for assignments through large digital networks. He had good technical skills, but contracts were shorter than they used to be, and travel costs were increasingly deducted from payments.

“We'll manage,” Nasrin said.

He looked at her. “You always say that.”
“Usually we do.”

Asher placed the repaired case beside the door. He kissed Samira, who was still half asleep at the kitchen table, then went into the next room to say goodbye to Abdul.

Nasrin heard her father ask where he was going.

“To work,” Asher replied.
“Where?”
“North of the city.”
“Will you be back for dinner?”
“Not tonight.”

There was a pause.

“Then take something to eat.”

When Asher returned, his expression had changed. Nasrin knew that her father had probably offered him money or asked him to bring a message to someone who had died many years earlier.

She walked him to the door.

“Call when you arrive,” she said.
“I will.”

After he left, she turned back towards the apartment. It was a narrow modular unit on the outskirts of Dhaka, built in a district where older residential areas had gradually been replaced by temporary and semi-permanent housing. The building had reliable water for most of the day, but its electricity allocation varied according to demand and the cost of the regional supply.

The unit was leased through Asher's employment network. Their eligibility depended partly on his continued assignment activity.

Nasrin disliked thinking about that.

At half past six, she helped Abdul wash and dress. He was cooperative until she tried to change his shirt.

“This isn't mine,” he said.
“It is, Baba. You wore it yesterday.”
“No. Mine is blue.”

She found the blue shirt. It was old and had a missing button, but he relaxed when she handed it to him.

While he ate breakfast, she checked his medication and measured his blood pressure. The readings were transmitted to a remote care service, which monitored his condition and flagged changes requiring medical attention.

The service had sent three automated reminders during the previous week. His sleep pattern was becoming irregular. His walking activity had declined. His medication should be reviewed.

Nasrin knew all of this.

She wondered what the monitoring system was expected to achieve when no one was available to help her with the work it identified.

At seven, Samira began her lessons.

The school programme combined remote instruction with occasional sessions at a local learning centre. Samira was supposed to attend the centre twice a week, but the journey required transport that Nasrin could not always afford. On those days, she completed her work at home.

Today the connection failed during a mathematics lesson.

Samira called from the other room.

“Ma, the teacher has disappeared.”
“Try reconnecting.”
“I've tried.”
“Use the recorded lesson.”
“It isn't available until the teacher approves it.”

Nasrin came to the doorway. Her daughter was sitting at a small desk beside the window, with a notebook open and an expression of growing frustration.

“Can you work on something else?”
“I've finished everything else.”

Nasrin checked the connection. The local network was functioning, but the education provider had suspended access to several services because a monthly payment was overdue.

She opened the account.

The amount was not large. It was simply more than they could pay that morning.

She considered transferring money from the household's emergency reserve, then remembered the medication she needed to collect for her father.

“Give me an hour,” she told Samira.
“Will that fix it?”
“I hope so.”

Samira looked at her mother, then closed the screen.

“I can read my history book.”
“That would be good.”

Nasrin returned to the kitchen and checked the medicine cabinet. Abdul had enough tablets for three days. His prescription renewal had been approved, but the nearest available pharmacy was twenty-eight kilometres away. The local delivery service had no scheduled route through their district until the following week.

She contacted the pharmacy.

“Can you transfer the prescription to a closer provider?” she asked.

The assistant examined the record.

“There is no participating provider within your service zone.”
“Can you arrange an emergency delivery?”
“Your coverage doesn't include that option.”
“What if I pay?”

The price appeared on her screen.

Nasrin ended the call.

She could collect the medication herself, but she could not leave Abdul alone. Samira was old enough to sit with her grandfather for a short time, though Nasrin disliked asking her to take responsibility for his care.

She called a neighbour, Rupa, who occasionally helped when Nasrin needed to go out.

Rupa was at work.

“I could come after four,” she said.
“The pharmacy closes at five.”
“Then you'll need to be quick.”

Nasrin thanked her and began planning the afternoon.

At nine, she switched off the household's non-essential electrical equipment. The batteries were charged, and the water heater had completed its cycle. Abdul was sitting beside the window, looking out at the courtyard.

“Is your mother coming?” he asked.

Nasrin felt the familiar hesitation before answering.

“No, Baba.”
“She said she'd visit.”
“I know.”

He looked disappointed.

Nasrin sat beside him. She had learned that correcting his memories rarely helped. Sometimes it made him angry. More often, it caused a sadness he could not explain.

“Tell me about her,” she said.

He smiled.

For twenty minutes, he spoke about a woman he had married more than sixty years earlier. Some details were accurate. Others belonged to different people or places. He remembered their wedding, a small room near the river and a train journey taken before Nasrin was born.

She listened while keeping one eye on the clock.

At eleven, a notification appeared from the employment platform.

Local diagnostic assignment available. Duration: four hours. Immediate confirmation required.

Nasrin opened it.

A mobile clinic had stopped in a neighbouring district and needed a certified phlebotomist to assist with a scheduled diagnostic programme. The payment was sufficient to cover the education subscription, her father's medication and most of the household's food expenses for the following week.

The assignment began at two.

She read the conditions twice.

The platform required her to confirm professional availability and accept responsibility for reaching the clinic on time. It did not provide family-care support or transport.

Nasrin calculated the journey. With no delays, she could reach the clinic in forty minutes. She might finish by six and return before eight.

Rupa could stay with Abdul from four, but no one was available between two and four. Samira would be at home, yet her father sometimes became distressed when Nasrin was absent.

A message appeared.

Offer expires in 08:00 minutes.

She called the clinic.

“Could I begin at four instead?”
“We need someone from two,” the coordinator replied.
“I can stay later.”
“The diagnostic schedule finishes at six.”
“Can I bring my father with me?”

The woman hesitated.

“We don't have space for accompanying dependants.”
“He wouldn't interfere with the work.”
“I'm sorry. We have patients waiting.”

Nasrin understood. She had worked in similar clinics for years and knew how quickly an appointment schedule could fall behind.

She thanked the coordinator and ended the call.

The platform was still waiting for her decision.

For a moment, she considered accepting and asking Samira to supervise her grandfather until Rupa arrived.

Then she remembered the night Abdul had walked away from home.

Her daughter had been frightened for weeks afterwards. Nasrin had promised she would never leave them alone together for more than a short period.

The countdown reached one minute.

She pressed *Decline*.

A notice appeared.

Repeated declines may reduce eligibility for future assignments.

Nasrin put the device down.

She had declined three assignments during the previous month. Each time, the platform reduced the likelihood of offering her work. Its system interpreted refusal as a lack of availability, without distinguishing between someone unwilling to work and someone unable to accept a particular schedule.

She wondered how long it would be before her qualifications ceased to matter.

In the afternoon, Abdul fell asleep in his chair. Nasrin used the time to submit a request for family-care support through the district social services system.

The form asked for the number of hours she worked each week.

She entered zero.

It asked whether she was actively seeking employment.

She selected yes.

A further question asked why she had not accepted available work.

Nasrin read the options. They included illness, inadequate transport, insufficient qualifications and personal preference.

There was no category for providing full-time care to a dependent relative.

She selected *Other* and explained her circumstances in the space provided.

The system requested evidence.

She uploaded her father's medical records, the reports from the remote care service and documentation of the assignments she had declined.

A message confirmed receipt.

Estimated processing time: 30–45 days.

She had submitted a similar request six months earlier. That application was still under review.

At four, Rupa arrived. Nasrin thanked her, explained Abdul's medication schedule and left on the small electric motorcycle she shared with Asher.

The journey to the pharmacy took longer than expected because part of the main road was closed for maintenance. By the time she arrived, the afternoon queue extended outside the building.

She waited forty minutes.

The pharmacist checked the prescription and retrieved the medication.

“Your father's care provider has recommended a review,” she said.
“I know.”
“Has he seen the specialist?”
“Not yet.”
“The consultation can be done remotely.”
“They want a responsible adult present, and the appointment times are always during the morning.”
“Could your husband attend?”
“He works away.”

The pharmacist looked at her for a moment.

“There's a community care service in the southern district. Have you contacted them?”
“Yes. They don't cover our residential zone.”
“Perhaps they could make an exception.”

Nasrin almost laughed. She had spent months asking institutions to make exceptions.

Instead, she thanked the pharmacist, paid for the medication and began the journey home.

When she arrived, Samira was sitting with Abdul at the kitchen table. They were looking at an old photograph album that Nasrin had not opened for years.

Rupa had prepared tea.

“He's been calm,” she said. “They've been talking about the photographs.”

Nasrin looked at the album. One picture showed her father standing beside a river with his younger brother. She recognised the place from childhood, though much of the surrounding neighbourhood had since changed.

“Baba, do you remember that day?” she asked.

He smiled.

“We went fishing.”

Nasrin knew they had not been fishing. Her uncle had taken the photograph during a family celebration.

But she sat down and listened.

After Rupa left, Nasrin prepared dinner. Samira helped wash the vegetables and asked whether the school account had been restored.

“Not yet,” Nasrin said.
“Can I still take the examination?”
“We'll find a way.”

Samira was silent for a moment.

“Could I get a job?”

Nasrin turned towards her.

“What kind of job?”
“I could do small tasks online. Some of the older students earn money that way.”
“You're twelve.”
“Some of them are thirteen.”
“That doesn't make it a good idea.”

Samira lowered her eyes.

“I just thought I could help.”

Nasrin sat beside her daughter. She wanted to tell her that children should not have to worry about household finances, but Samira already did. She understood why her father travelled, why her mother checked the electricity prices and why her grandfather could not be left alone.

“You are helping,” Nasrin said. “You help your grandfather, and you do your schoolwork. That's enough.”
“But you can't work because of us.”

Nasrin felt the words more sharply than she expected.

“That's not how it is.”
“It is a little.”

She looked at Samira, trying to find an answer that was both reassuring and true.

“I stopped travelling because your grandfather needs someone here,” she said. “That doesn't mean caring for him isn't work.”
“Then why doesn't anyone pay you?”

Nasrin had no answer.

Later, after Samira went to bed, she checked the employment platform again. The assignment she had declined was no longer visible. Her availability rating had fallen, and a notice advised her to accept future offers to maintain professional eligibility.

She opened the care-support application. Its status remained unchanged.

Then she returned to the list of local diagnostic providers. One community clinic was seeking staff for occasional home visits. The pay was lower than the mobile network's rates, but the work was closer to home.

She sent a message explaining her qualifications and asking whether assignments could be scheduled in advance.

The clinic replied within an hour.

It could offer work on two mornings a week, provided she arranged her own transport and insurance.

Nasrin read the message carefully.

It was not enough to support the household. But it might allow her to begin working again if she could find reliable care for her father.

She opened a new message to the district social services office.

This time, instead of requesting another individual exception, she asked for information about the local authority's responsibility to provide support for dependent adults whose family caregivers could not participate in mobile employment.

She described her father's condition, her professional qualifications and the difficulties created by the existing arrangements.

Then she added a question.

How can a household maintain access to employment and essential services when a member of the family is unable to travel and requires continuous care?

She sent the message.

Outside, vehicles moved along the road towards the northern districts. Some carried workers beginning overnight assignments. Others transported equipment, medicine and goods between service centres.

The economy continued moving around her.

Nasrin checked on her father before going to bed. He was asleep, one hand resting on the blue shirt she had folded beside his pillow.

She adjusted the blanket and sat for a moment in the quiet room.

Years earlier, she had enjoyed travelling with the medical teams. She had liked arriving in unfamiliar places, meeting colleagues and finding her way through towns she had never visited before. She did not regret that part of her life.

But she had never imagined that remaining with someone who needed her could cost so much.

In the morning, the electricity would be cheaper before nine. Asher would be several hundred kilometres away, and Samira would try again to join her classes.

Nasrin would make breakfast, help her father dress and check for a reply from the community clinic.

She had no reason to expect that the system would change overnight.

Still, she wanted someone to answer her question.

7.7 The Water Assembly

Figure 7.7. Rahmat Ali and his sixteen-year-old apprentice Daniyal inspecting a communal irrigation channel in the Arkari Valley, Chitral, Pakistan, Planetary Transition scenario, 2100.

Fictional future visualisation created for TEOS 2100.



Rahmat Ali knew the sound of water before he could remember his own name. As a boy, he had followed his father along the irrigation channels above their village, carrying a wooden shovel that was too heavy for him. His father had taught him to listen for the difference between water passing over stone and water escaping through a damaged wall.

Now, at sixty-seven, Rahmat still walked the channels every morning. He no longer carried the shovel. His knees had become unreliable on steep ground, and the cooperative had replaced much of the old infrastructure with covered conduits and adjustable distribution gates. But he preferred to inspect the system himself before looking at its measurements.

Daniyal was already waiting beside the upper gate when Rahmat arrived.

“You're late,” the boy said.
“I'm old.”
“You were old yesterday. You were on time.”

Rahmat smiled and leaned on his walking stick.

Daniyal was sixteen, tall and thin, with a habit of speaking before he had finished thinking. He had worked with Rahmat for almost two years, first during school holidays and later as part of a practical learning programme that allowed young people to combine study with work in local enterprises.

His father repaired agricultural equipment in the lower valley. His mother taught at the district learning centre. Daniyal could have chosen several other placements, including one at the regional energy station, but he preferred working outdoors.

He said the fields were more interesting than machines because the machines never did what the weather expected.

Rahmat suspected that the boy simply disliked sitting in classrooms.

“Show me,” he said.

Daniyal opened the monitoring record on his device. The upper catchment had received less water than anticipated during the previous fortnight. Soil moisture remained adequate in the lower fields, but the terraces near the village had begun to dry.

The cooperative's seasonal allocation model recommended reducing irrigation for the older orchards and preserving water for the vegetable plots supplying several settlements.

Rahmat examined the figures.

“Again?”
“The forecast hasn't improved.”
“Last week it said we would have enough until the end of the month.”
“Last week it was using the earlier inflow estimate.”

Rahmat looked towards the mountains. The highest slopes remained pale with patches of old snow, but the lower ridges were dry. A narrow stream descended from a ravine above the village and entered the main storage basin.

When Rahmat was young, the stream had been less predictable. Sometimes it brought enough water to damage the channels. At other times, it weakened before the harvest. The village had spent decades improving storage and repairing damaged catchments, but no amount of engineering could make every season reliable.

“Open the inspection gate,” he said.

Daniyal entered the command. The gate moved slowly, releasing a controlled flow into the side channel.

Rahmat watched the water settle.

“Not too much.”
“It's within the limit.”
“I can see that.”
“Then why do you always say it?”
“Because one day you might forget.”

Daniyal shook his head.

They continued towards the orchard. Rahmat's family had cultivated apricots there for three generations. The trees occupied a narrow terrace above the village, where the soil was deep enough to retain moisture but the summer heat could be severe.

Several trees had already been replaced with varieties better suited to changing conditions. Others were too old to produce reliable harvests, yet Rahmat had kept them because their roots helped stabilise the terrace.

Daniyal had repeatedly suggested replacing the least productive trees with vegetables grown under shade structures.

Rahmat had refused.

“You can't eat memories,” Daniyal had told him.

“No,” Rahmat replied. “But you can lose a great deal by removing things you don't understand.”

They had been arguing about the orchard for almost a year.

That morning, Daniyal stood beneath one of the older trees and examined the soil.

“If we accept the new allocation, this section won't survive another dry season.”

Rahmat looked at him.

“I know.”
“Then we should object.”
“We haven't heard the full proposal.”
“The figures are here.”
“The figures aren't the proposal.”

Daniyal looked unconvinced.

The Water Assembly was meeting that afternoon. Every registered resource-user group in the catchment would send representatives, including farmers, livestock keepers, residents of the village and operators of essential public facilities. The assembly had authority to recommend seasonal allocations under the regional water-management framework.

Its decisions were not always unanimous. Sometimes they were barely accepted.

Rahmat had attended meetings of its predecessor for most of his adult life. He remembered disputes conducted in courtyards, beside channels and once in the middle of a field when two families refused to leave their disputed irrigation gate.

The modern assembly used digital records and published its decisions. It also had a formal procedure for challenging allocations. Yet arguments about water remained much as they had been when he was young.

People needed it. There was rarely enough to give everyone what they wanted.

At noon, Rahmat and Daniyal returned to the village.

The assembly met in a low public building beside the cooperative workshop. Its walls were made from stone recovered from older structures, while the roof supported solar panels and a small rainwater collection system.

Inside, a large display showed the catchment's water balance. The figures were updated from monitoring stations distributed across the valley.

About forty people had gathered. Some were farmers, others represented households or public institutions. A few had travelled from neighbouring settlements connected to the same storage network.

Rahmat found a seat near the front.

Daniyal sat beside him, although he had no voting rights. The youth learning programme allowed apprentices to attend and contribute technical observations when invited.

The assembly's chair, a woman named Shazia, opened the meeting.

“The total seasonal allocation must be reduced,” she said. “We have three proposals.”

The first proposal would maintain established irrigation shares while applying the same percentage reduction to all agricultural users.

The second would give greater priority to food production, reducing water for orchards and less productive fields.

The third combined a smaller agricultural reduction with temporary restrictions on non-essential household consumption and additional withdrawals from the reserve.

Each option involved consequences.

The first placed the greatest burden on farmers with already limited allocations. The second threatened established orchards and livestock feed production. The third reduced the reserve available for unexpected dry conditions.

Shazia invited the technical coordinator to explain the assessments.

Daniyal followed the presentation closely. Rahmat watched the faces around the room.

He knew who had recently planted new crops, whose children had returned from work elsewhere and which households depended on income from their orchards. Those details did not appear in the water balance.

When the presentation ended, Shazia opened the discussion.

A vegetable grower from the lower valley spoke first.

“We produce food for six settlements. If we lose irrigation now, the next harvest will be reduced.”

An older orchard owner stood up.

“You cannot protect one crop by sacrificing another.”
“The vegetables mature this season.”
“And the trees take twenty years to replace.”
Several people spoke at once.

Shazia asked them to wait their turn.

Rahmat listened as the discussion continued. The arguments were familiar, but their consequences had changed.

The cooperative's ecological restoration programme had improved soil retention and reduced losses along several channels. Water use was monitored more effectively, and the region had avoided some of the disruptions experienced by neighbouring valleys.

Yet the improvement had encouraged new investment. More people cultivated land, and some families who had previously moved away had returned.

The increased demand was now part of the allocation problem.

Success had not removed competition. It had changed its shape.

Daniyal leaned towards Rahmat.

“They're using the wrong baseline.”
“What?”
“The yield estimates. They assume the older orchards use as much water as the new ones.”
“Do they?”
“Not all of them. We changed the irrigation schedule last year.”

Rahmat looked at the display.

“Are you certain?”
“I recorded it. The sensor data is in the cooperative archive.”
“Show me.”

Daniyal opened the files and compared the figures.

The difference was modest but significant. Rahmat's orchard and several neighbouring fields had reduced their water use through changes to irrigation timing and soil management.

The allocation model had treated those improvements as temporary rather than including them in the new baseline.

Rahmat examined the calculations.

“Tell Shazia.”

Daniyal hesitated.

“I'm not a representative.”
“You're the person who has the records.”
“That doesn't mean they'll listen.”

Rahmat raised his hand.

When Shazia recognised him, he stood slowly.

“I'd like my apprentice to show the assembly something.”

A few people turned towards Daniyal.

Shazia nodded. “He may present the information.”

Daniyal connected his device to the display. His first explanation was too fast, and someone asked him to begin again.

He took a moment.

“The allocation model uses last year's expected water demand,” he said. “But several orchards used less than expected. We changed the irrigation schedules and recorded the results. If those savings are included, the proposed reduction doesn't have to be distributed in the same way.”

The coordinator examined the data.

“These records were never certified for the regional model.”
“They were submitted in September.”
“They weren't incorporated into the final assessment.”
“Why not?”

The coordinator looked uncomfortable.

“The update was delayed.”

Daniyal glanced at Rahmat.

Rahmat said nothing.

Shazia asked whether the figures could be verified.

The coordinator replied that most of the measurements were already available through the monitoring system. The issue was not their reliability but their classification.

The meeting paused while the technical team recalculated the allocation options.

Rahmat and Daniyal went outside.

The afternoon sun had moved behind the ridge, leaving the courtyard in shadow. A few farmers stood talking near the entrance.

“You did well,” Rahmat said.

Daniyal shrugged.

“They still might cut the water.”
“Probably.”

“Then what was the point?”
“The point was that they should make the decision using the right information.”

Daniyal sat on the low wall.

“I thought if we showed them the savings, they'd leave the orchard alone.”

Rahmat looked towards the fields beyond the village.

“We've saved water. That doesn't mean we own what we've saved.”
“Why not? We did the work.”
“Because we use the same catchment as everyone else.”
“Then why should anyone invest in saving water?”

Rahmat considered the question.

“When your grandfather helped build the storage basin, he spent almost two years working on it. Some families contributed money. Others worked. Everyone was supposed to benefit.”
“Did they?”
“Not equally.”
“Then how was that fair?”
“It wasn't always.”

Daniyal looked at him with surprise. He was accustomed to Rahmat defending the cooperative's institutions, even when he complained about their decisions.

“You still support the assembly.”
“Yes.”
“Even when it makes decisions that hurt us?”
“That's when we find out whether it works.”

Before Daniyal could reply, Shazia called everyone back inside.

The revised figures had changed the assessment. The reduction required from existing orchards was smaller than originally proposed, but the catchment still faced a shortfall.

The technical team recommended a fourth option: a temporary reduction across agricultural users, greater protection for essential food production and a limited reserve withdrawal subject to monthly review.

Several representatives remained dissatisfied.

One argued that drawing on the reserve created unacceptable risks. Another said that the burden on orchard owners was still too high.

A younger farmer asked why returning households should receive water while established farmers were being asked to reduce their allocations.

The room became quiet.

The question touched a dispute the assembly had postponed for years.

Several families had returned to the valley after changes in regional employment and adaptation investment made local livelihoods more attractive. Their rights to land were recognised, but access to water depended on cooperative membership and the availability of resources.

Some established users believed newcomers were receiving benefits from infrastructure they had not helped build.

Others argued that maintaining a viable community required allowing people to return.

Shazia invited comments.

Rahmat remained seated.

Daniyal looked towards him.

“Say something,” he whispered.
“What would you like me to say?”
“That they should be allowed to stay.”
“Is that what you think?”
“Yes.”
“Then say it.”
“I can't vote.”
“You can speak.”

Daniyal stood.

“I've lived here all my life,” he began. “My parents stayed when other families moved away. I know people who came back. Some of them are my friends.”

He paused.

“I want to farm here when I'm older. But if the rules mean that only families who already have water can continue farming, what happens to people who are starting?”

A representative from an established orchard cooperative replied.

“We cannot promise everyone water that doesn't exist.”
“I know,” Daniyal said. “But we also can't tell young people to stay here and then say there's no place for them.”

Several people nodded.

Rahmat watched the discussion unfold. He had expected Daniyal to defend the orchard. Instead, the boy was asking how the community would make room for people who did not yet have established rights.

It was a question Rahmat had seldom needed to ask for himself.

He had inherited land, membership and an irrigation share. He had worked hard to maintain them, but he had never entered the system as an outsider.

When Shazia called for the vote, the fourth allocation proposal received a narrow majority.

It would protect essential water uses, reduce agricultural allocations for the coming season and require the cooperative to review how efficiency savings were recognised. A separate working group would examine the rules governing access for returning households and new farmers.

Rahmat voted in favour.

Several orchard owners voted against it.

As the meeting ended, one of them approached him.

“You've agreed to damage your own trees.”
“Perhaps.”
“For what?”

Rahmat looked towards Daniyal, who was packing away the monitoring equipment.

“For a decision we can live with.”

The man shook his head and walked away.

On the way home, Daniyal was unusually quiet.

“Are you angry?” Rahmat asked.
“About what?”
“The orchard.”
“I thought you'd vote against the proposal.”
“So did I.”
“Then why didn't you?”

Rahmat stopped beside the upper channel. Water passed beneath the inspection bridge, moving towards the village.

“When I was your age, I believed my father knew where every drop should go,” he said. “Later, I thought I did. Now I know neither of us ever had the whole answer.”

Daniyal leaned on the railing.

“What if the trees die?”
“Then we'll lose some trees.”
“You make that sound easy.”
“It won't be easy.”

They stood for a while without speaking.

Farther down the valley, the lights of the village were beginning to appear. The cooperative workshop was still open, and a small vehicle carried tools towards one of the lower fields.

Rahmat thought of the orchard, the old trees and the years he had spent trying to keep them productive. He was not certain he had made the right decision.

But he knew that if every farmer demanded an allocation sufficient to preserve everything they owned, the assembly would soon have nothing meaningful to decide.

“Come tomorrow,” he said.

Daniyal looked at him.

“We'll need to change the irrigation schedule again.”
“And the oldest trees?”
“We'll inspect them first.”
“You said you wanted to remove them.”
“I said they use water.”
“They do.”
“And you said some things are worth keeping.”

Rahmat smiled.

“You've been listening.”
“Sometimes.”

They continued along the path.

At the entrance to the orchard, Daniyal stopped.

“Rahmat?”
“Yes?”
“When I'm your age, do you think there'll still be farming here?”

Rahmat looked towards the darkening terraces.

“I don't know.”

Daniyal waited.

“But if there is,” Rahmat added, “you'll have to make decisions for people who haven't been born yet.”

The boy looked at the channel, then at the orchard.

“That's a lot of responsibility.”
“It is.”

Rahmat opened the gate, and they walked home.

7.8 The Right to Belong

Figure 7.8. Haroon Safi, an irrigation technician from Afghanistan's Badakhshan region, seeking membership in a water cooperative in the Arkari Valley, Chitral, Pakistan, Planetary Transition scenario, 2100.

Fictional future visualisation created for TEOS 2100.



Haroon Safi had repaired the eastern irrigation gate three times before anyone asked whether he intended to stay in the valley.

The first repair had been routine. A damaged sensor was sending inaccurate readings to the cooperative's monitoring system. The second involved a worn mechanical joint that prevented the gate from closing fully. The third required replacing a control unit that had not been designed for the sediment carried by the mountain streams.

Haroon had completed the work, submitted his reports and received payment through the regional maintenance cooperative. The farmers were satisfied. Water losses fell, and the distribution system operated more reliably.

Only when he applied for a small agricultural plot did his place in the community become a matter for discussion.

He was twenty-nine and had been born near Faizabad in Afghanistan's Badakhshan region. His father repaired agricultural machinery, and his mother had worked in a district health centre. As a child, Haroon spent long afternoons beside his father's workshop, watching pumps and engines being dismantled and assembled again.

He had learned to recognise mechanical problems by their sounds. A pump operating against an obstruction made a different noise from one running with a damaged bearing. His

father considered that knowledge more valuable than the diagnostic equipment customers brought to the workshop.

Later, Haroon studied water systems maintenance and worked on irrigation infrastructure in several mountain districts. His employment took him away from home for months at a time. He liked the work, but after a decade of moving between temporary assignments, he wanted a place of his own.

He had come to Chitral through a regional technical exchange programme. The cooperative needed someone familiar with older irrigation equipment and newer automated controls. Haroon possessed both skills.

At first, he had expected to remain for six months. Then the cooperative extended his contract. After two years, he knew the irrigation channels, the roads and most of the people who depended on them.

He knew where the upper stream carried sediment after heavy rainfall and which gates were likely to freeze during cold weather. He had learned enough Khowar to follow conversations in the workshop, although he still spoke Dari when he called his family.

He had friends in the valley. He rented a room above a small shop and bought vegetables from the same family every week. The baker sometimes put aside bread for him when he was working late.

These arrangements made life comfortable. They did not make him a member of the water cooperative.

On the morning after the Water Assembly, Haroon walked to the cooperative office carrying an application for agricultural membership.

He had been offered a lease on a small piece of land near the lower terraces. The previous tenant had moved to another district, and the owner no longer wished to cultivate it himself.

Haroon wanted to grow vegetables and establish a small nursery producing seedlings suited to the valley's changing growing conditions.

It was not a large business plan. He had calculated the costs, identified potential customers and saved enough money to support himself through the first year.

The difficulty was water.

Under the cooperative's rules, irrigation allocations were linked to registered plots and recognised resource-user membership. A lease did not automatically transfer the right to an existing water allocation.

The owner had previously cultivated the land, but his share had been suspended when the field was taken out of production. Reinstatement required approval.

Haroon believed the application would be straightforward. The field was small, and he had designed a low-volume irrigation system that would use less water than the earlier cultivation methods.

The cooperative secretary examined his documents.

“Your residence permit is valid,” she said.
“I renewed it last month.”
“And the lease?”
“Signed for ten years.”

She checked the record.

“The owner is registered. You are not.”
“That's why I'm applying.”
“Membership applications are suspended until the new resource-access rules are approved.”

Haroon looked at her.

“When will that happen?”
“The working group begins next week.”
“How long will it take?”
“I don't know.”

He had heard that answer before, in other offices and other districts.

“Can I attend the meeting?”
“You can request permission to observe.”
“Can I speak?”
“That depends on the chair.”
“And vote?”

She looked up.

“Only registered members can vote.”

Haroon thanked her and left.

Outside, a group of farmers were discussing the previous day's allocation decision. Several recognised him and asked about the eastern gate. One complained that the new water restrictions would affect his orchard. Another said the assembly had been too generous with the reserve.

They spoke freely in front of Haroon, as they often did when discussing technical matters.

But when he mentioned his application for membership, the conversation changed.

A farmer named Karim asked how much land he intended to cultivate.

“Less than half a hectare.”
“With water from our system?”
“Yes.”

Karim shook his head.

“We've just reduced everyone's allocation.”
“I know.”
“Then why should we give water to another farm?”

Haroon explained his irrigation plan.

Karim listened without enthusiasm.

“Every new farmer says he'll use less water.”
“I can show you the calculations.”
“Calculations don't create water.”

Haroon had no answer to that.

He knew the farmer was right about one thing. Even an efficient irrigation system required water that someone else might have expected to use.

He had spent his career improving distribution systems. Until now, he had rarely needed to defend his own claim on the resources they carried.

Later that morning, he visited the eastern gate.

Daniyal was checking the control records, and Rahmat stood beside the channel, leaning on his walking stick.

“Have you seen the latest measurements?” Haroon asked.

Daniyal nodded.

“The gate is operating properly.”
“For once,” Rahmat said.

Haroon smiled.

“Then perhaps you should stop asking me to repair it.”
“We'll find something else for you to do.”

Daniyal looked at the documents under Haroon's arm.

“What's that?”
“My application for cooperative membership.”

Rahmat raised his eyebrows.

“You're planning to farm?”
“If they'll let me.”
“Where?”

Haroon described the field and his plan for a nursery.

Daniyal was immediately interested. He asked about the proposed irrigation system, the growing beds and whether Haroon intended to use soil monitoring.

Rahmat listened quietly.

When the boy finished asking questions, Rahmat turned to Haroon.

“Have you spoken to the water committee?”
“They've suspended new memberships.”
“Yes. We decided that yesterday.”
“I heard.”
“Then you'll have to wait for the review.”

Haroon looked towards the channel.

“I've helped maintain this system for two years.”

Rahmat nodded.

“I know.”
“I've repaired gates, trained technicians and worked through the last two dry seasons.”
“We're grateful for that.”
“But gratitude doesn't give me a right to use the water.”

Rahmat was silent.

Daniyal looked from one man to the other.

“That's what I was talking about yesterday,” he said.

Rahmat gave him a brief glance.

“I remember.”

Haroon regretted the sharpness in his voice. Rahmat had treated him fairly since his arrival and had recommended him for several maintenance contracts.

“I don't expect anyone to give me water without rules,” he said. “I want the chance to apply under rules that recognise what I contribute.”

Rahmat considered this.

“Come to the working group next week.”
“They said I might be allowed to observe.”
“I'll ask Shazia to let you speak.”

Haroon thanked him.

As he turned to leave, Daniyal called after him.

“Can I see the nursery design?”

Haroon handed him the file.

“Don't change anything.”

Daniyal grinned.

“I haven't promised that.”

During the following week, Haroon continued his maintenance work and prepared for the meeting. He examined the field again, measured the soil and revised the irrigation plan to reflect the lower seasonal allocation approved by the assembly.

The original design was no longer viable.

He would need to reduce the growing area and delay planting some crops. The nursery could still work, but the first year's income would be lower.

He considered abandoning the idea.

His maintenance contracts paid enough to cover his rent and living expenses. He could continue working across the region without taking on the risks of farming.

Yet that would mean accepting the same temporary existence he had wanted to leave behind.

His employment allowed him to remain in Chitral, but it could end when the cooperative no longer needed him. The room above the shop was rented month by month. He had friends but no recognised stake in the future of the valley.

He wanted to build something that would remain when his next maintenance contract ended.

On Sunday, he called his mother.

She was sitting outside her house in Badakhshan, sorting dried fruit into small containers.

“Have they approved the land?” she asked.
“Not yet.”
“Why not?”
“The water rights are complicated.”
“They are complicated everywhere.”

Haroon laughed.

She asked whether he intended to return home.

“I don't know.”
“You say that every time.”
“Perhaps I could come for a few months.”
“And after that?”
“I want to establish the nursery here.”

His mother looked at him through the screen.

“Then you should try.”
“Even if they don't accept me?”
“Do they pay you for your work?”

“Yes.”
“Do you have friends?”
“Yes.”
“Are you safe?”
“Yes.”
“Then perhaps they already accept part of you.”

Haroon thought about that.

“It's the other part I'm asking for.”

His mother smiled.

“People are slower than machines.”

The working group met on Wednesday afternoon.

Unlike the full Water Assembly, it consisted of twelve representatives from the cooperative, the municipality and local resource-user groups. Shazia chaired the meeting. Rahmat was present as an elected representative of the orchard farmers. Daniyal attended through the youth learning programme.

Haroon had been invited to present his application.

He was not the only applicant. Two families who had returned to the valley wanted to reactivate previous irrigation rights. Another household had recently leased land from an ageing relative.

Their circumstances differed, but the underlying question was the same: who should be allowed to join a system whose resources were already allocated?

Shazia opened the discussion by reviewing the cooperative's existing rules.

Membership had traditionally been connected to established land use and contributions to maintaining the irrigation system. Over time, the cooperative had introduced additional provisions for tenants, returning households and people involved in communal infrastructure.

However, the rules had developed incrementally. Some provisions contradicted others.

A returning household could sometimes reclaim an allocation that had been unused for years, while a tenant cultivating the same land might have no independent rights.

People working for the cooperative could participate in technical decisions but not necessarily in resource-allocation votes.

Shazia described the situation without defending it.

“We need rules that can be understood and applied,” she said. “And we need to decide how new members can enter without promising water we don't have.”

The first applicant was a woman whose family had returned after years of employment elsewhere. She wanted to reopen two terraces that had been abandoned when her parents moved away.

A representative asked whether the family had contributed to recent infrastructure repairs.

“No,” she said. “We weren't living here.”
“Then why should you receive the same allocation as families who stayed?”
“Because the land is still ours.”
“The land, perhaps. But the water is shared.”

The discussion continued for half an hour.

When Haroon's turn came, he stood and connected his design to the display.

He explained the proposed nursery, the expected water demand and the measures he would use to reduce losses. He also described the maintenance work he had completed during the previous two years.

“The nursery could supply seedlings to farmers adapting their crops,” he said. “I would sell some locally and use part of the land to test varieties that require less irrigation.”

A representative from the livestock association asked whether he intended to employ local workers.

“If the nursery grows, yes.”
“And if it fails?”
“Then I lose my investment.”
“What happens to the water allocation?”
“It should return to the cooperative.”

Rahmat looked up.

“That isn't in your application.”
“It should be.”

Shazia asked him to explain.

Haroon had considered the question during the previous week. He knew that some people feared new users would obtain rights that remained attached to the land even if the original activity ended.

“I don't think the right should be permanent,” he said. “Not until I've shown that the nursery works and that I can meet the conditions.”
“Then what are you asking for?” Shazia asked.
“A provisional allocation for three years. Reviewed annually, with the same limits applied to other users.”

Several members began taking notes.

Haroon continued.

“I would contribute to maintenance according to the cooperative's rules. I would accept the monitoring requirements. If the nursery uses more water than agreed, the allocation could be reduced or suspended.”
“And voting rights?” asked a representative.

Haroon hesitated.

“I would like to participate in decisions that affect my work.”
“That isn't the same as full membership.”
“No,” he said. “But if I'm responsible for following the rules, I should have some way to influence them.”

The room fell quiet.

Rahmat shifted in his chair.

For much of his life, he had understood water rights through land and family membership. People inherited obligations as well as benefits. They worked on the channels, attended meetings and accepted decisions made by the community.

Haroon did not possess that history.

Yet he had helped maintain infrastructure that established members depended on. The cooperative had trusted his technical judgement while remaining uncertain whether he should share in its governance.

Rahmat looked towards Daniyal, who was following the discussion closely.

The boy caught his eye but said nothing.

Shazia asked the working group to consider the proposal.

One member argued that provisional allocations could encourage more people to apply than the valley could support.

Another suggested limiting new membership to people with family connections in Chitral.

Haroon listened without interrupting.

Then Rahmat spoke.

“When we built the first storage basin, people argued about who should have access,” he said. “Some families had contributed more labour. Others had more land. We spent months deciding what was fair.”

He paused.

“We eventually agreed that using the system meant helping maintain it. That rule served us well.”

Several people nodded.

“But we've changed the system since then. We now employ technicians from other regions. We rely on people whose families were not here when the channels were built.”

A representative interrupted.

“Are you suggesting we give everyone the same rights?”
“No.”
“Then what?”
“That we recognise more than one way of belonging to the cooperative.”

Haroon looked at him.

Rahmat continued.

“Someone who owns land and has worked here for forty years has a different relationship with the system from someone who arrived last year. But that doesn't mean the second person has no relationship at all.”

Shazia asked whether he supported the provisional allocation.

“I support considering it under conditions we can apply to everyone.”

Daniyal raised his hand.

The chair nodded.

“I think we should separate the right to use water from the right to participate,” he said.

Several representatives looked towards him.

“Not everyone needs the same allocation. But people who work here and are affected by the rules should be heard, even if they don't own land.”

He glanced at Haroon.

“If we want young people to build their lives here, we can't make inheritance the only way to enter.”

Rahmat smiled faintly.

The meeting continued for another hour.

In the end, the working group recommended a new provisional membership category for applicants without established hereditary or long-term resource rights.

Applicants would need a recognised residence or land-use arrangement, an approved resource plan and a commitment to contribute to communal maintenance.

Allocations would remain subject to environmental conditions and periodic review.

Provisional members would be able to participate in consultations and elect a representative to the Water Assembly. Full voting rights concerning long-term allocations would require a further period of membership and approval under rules still to be developed.

The recommendation would go to the full assembly for a vote.

Nothing had been granted yet.

After the meeting, Haroon found Rahmat and Daniyal outside the building.

“Thank you,” he said.

Rahmat waved the words away.

“You haven't received any water.”
“I know.”
“The assembly may reject the proposal.”
“I know that too.”
“Then don't thank me yet.”

Daniyal grinned.

“He's like this with everyone.”

Rahmat ignored him.

“Your nursery design needs work,” he told Haroon.

Haroon looked at him.

“I've already revised it three times.”
“Then a fourth won't hurt.”

Daniyal laughed.

They walked together towards the upper channel. The afternoon light was beginning to fade, and the first shadows had reached the terraces.

Haroon showed them the amended irrigation plan. Daniyal immediately suggested a different position for the storage tank.

Rahmat disagreed, pointing out that the proposed location would interfere with an older drainage channel.

Haroon listened as they argued.

He had spent much of his working life arriving in communities, solving technical problems and leaving before the next season. He had learned how to make himself useful without becoming involved in local disputes.

Now he was arguing about the placement of a water tank on land he might never be allowed to cultivate.

It felt strangely familiar.

Near the orchard, Rahmat stopped to inspect a gate. Daniyal climbed down beside the channel and checked the flow.

Haroon stood above them, looking across the valley.

He could see the field he hoped to lease. It was small and partly overgrown, bordered by a low stone wall that had begun to collapse. Beyond it were cultivated terraces, houses and the road leading towards the lower valley.

He had imagined the nursery there many times. He knew where the growing beds would stand and how he would protect young plants from strong winds.

He had not imagined how much of the work would involve people rather than irrigation equipment.

Rahmat joined him.

“You could find land somewhere easier,” the older man said.
“Probably.”
“Then why stay here?”

Haroon thought about the question.

He could have explained the contracts, the climate or the opportunities he saw for the nursery. All of those mattered.

Instead, he looked towards the channel where Daniyal was still working.

“Because I've started to care what happens here.”

Rahmat followed his gaze.

“That can be expensive,” he said.
“I've noticed.”

They stood together for a moment.

Then Daniyal called for help. A measuring instrument had become stuck beneath a loose stone, and he could not free it without disturbing the gate.

Haroon climbed down to him.

“Move your hand,” he said. “You'll damage the housing.”
“I know what I'm doing.”
“That's what people say before I have to repair something.”

Daniyal laughed and stepped aside.

Haroon released the instrument, checked the reading and returned it to its position.

The water continued through the channel.

The assembly would vote the following month. Haroon might receive a provisional allocation, or he might have to abandon the nursery. Even if the application succeeded, he would face years of work before the business could support him.

He had no guarantee of remaining in the valley permanently.

Yet something had changed.

For the first time since arriving in Chitral, he was no longer asking only whether the community needed his skills.

He was asking whether he could share responsibility for its future.

7.9 The Lives Behind the Scenarios

The eight stories offer different perspectives on life in 2100. Their characters inhabit societies shaped by changing environmental conditions, but the difficulties they encounter are rarely caused by environmental change alone.

Nyima's teaching permit remains valid, yet she cannot reach her pupils. Mira lives in a protected city whose reliable water supply depends partly on decisions affecting communities beyond its boundaries. Asha's family can relocate through a recognised agreement, but no document can settle what leaving means to them. Farid must translate international commitments into housing and public services with limited municipal resources.

Amara can work across several countries until a private platform suspends her professional access. Nasrin possesses medical qualifications but cannot accept mobile assignments while caring for her father. Rahmat and Daniyal confront the limits of shared resources, while Haroon discovers that contributing to a community does not automatically grant the right to participate in its decisions.

Their situations differ, yet each reveals a relationship between individual lives and the institutions that organise them.

The difference between access and rights

Several characters encounter systems that recognise their needs without providing an effective way to meet them.

Nyima is qualified to teach. Nasrin is qualified to work. Haroon possesses skills valued by the community in which he lives. Nevertheless, each encounters restrictions that prevent professional recognition from becoming a secure basis for everyday life. The reasons differ.

In Fortress Earth, administrative boundaries determine whether Nyima may reach her pupils.

In Networked Nomads, Nasrin's employment opportunities depend on a system that does not adequately accommodate her care responsibilities.

In Planetary Transition, Haroon's access to agricultural resources remains subject to membership rules developed before he arrived.

These examples distinguish formal recognition from the practical ability to exercise rights. A society may record qualifications, maintain digital identities and establish legal entitlements while leaving individuals unable to use them. The existence of a system does not establish that it works for everyone who depends on it.

The freedom to move and the freedom to remain

The stories also question the assumption that increased mobility necessarily creates greater freedom.

For Asha's family, a negotiated mobility agreement expands the range of possible decisions. They can move to another country while retaining certain rights and connections to their home.

For Amara, international employment provides professional flexibility, but her livelihood remains dependent on access to a private network.

Nasrin faces the opposite problem. She once enjoyed travelling for work, but her father's need for care now requires her to remain in one place. The employment system treats this responsibility as a limitation on her availability rather than a form of necessary work.

Rahmat has spent most of his life in one valley. His attachment to that place has not prevented him from accepting changes to the way its resources are managed.

These experiences suggest that freedom cannot be measured by the frequency or distance of movement.

For some people, the ability to leave an environmentally exposed settlement may be essential to maintaining a secure life. For others, the ability to remain without losing access to employment or public services may be equally significant.

The relevant question is whether institutions preserve meaningful choices as circumstances change.

Responsibility beyond administrative boundaries

The stories reveal another difficulty: decisions made within one institution often affect people who have little influence over them.

Mira's water allocation model initially excludes the needs of communities outside the protected city. Farid must deal with the consequences of housing agreements and financing arrangements negotiated elsewhere. Amara's technical intervention restores an essential service, but a remote platform questions her authority to act.

In each case, the boundaries of institutional responsibility differ from the relationships through which people depend on one another.

Water crosses municipal boundaries. Employment networks operate across national jurisdictions. Families maintain relationships between places, and public services depend on financial decisions made at several levels of government.

An institution may fulfil its formal mandate while transferring costs or risks to people outside its area of responsibility. This is not unique to any one scenario. The difference lies in how societies recognise these relationships and provide mechanisms for addressing their consequences.

Belonging and participation

The final two stories make the question of belonging explicit.

Rahmat has inherited land-use rights and contributed to maintaining the valley's irrigation system. Haroon has arrived more recently, but his work has become valuable to the same community.

Both have legitimate interests. The difficulty is that established membership rules cannot automatically resolve claims arising from changing patterns of residence and economic activity.

The Water Assembly provides a procedure through which these interests can be considered. It does not guarantee agreement.

Similar questions arise elsewhere.

Asha's family retains connections to its place of origin while establishing a life in another country. Farid must respond to established residents who question how municipal resources are distributed. Nyima teaches children whose lives do not fit the administrative categories used to organise education.

Belonging therefore involves more than residence or nationality.

It concerns the ability to maintain relationships, contribute to shared institutions and participate in decisions affecting everyday life. These opportunities may exist in settled communities and across mobile populations. They may also be restricted in either setting.

Human agency under different futures

None of the characters controls the wider society in which they live. Their decisions are limited by resources, institutions and circumstances that extend beyond their immediate influence. Yet they are not simply passive recipients of those conditions.

Nyima finds a way to teach children at a checkpoint. Mira challenges a water allocation model. Asha negotiates a continued relationship with her home village. Farid seeks practical solutions to the municipality's obligations. Amara documents and undertakes an emergency repair. Nasrin questions the absence of support for unpaid care. Rahmat accepts a difficult collective decision, and Haroon proposes a new form of participation in the water cooperative.

These actions do not resolve the underlying problems. Some may have lasting consequences. Others may achieve little beyond the immediate situation. Their significance lies in showing how people exercise judgement and responsibility within the possibilities available to them. Institutions shape those possibilities, but they do not determine every individual decision.

What the stories contribute to TEOS 2100

The four scenarios present alternative ways of organising society under environmental pressure. The Human Stories examine what these arrangements might mean for people whose lives cannot be reduced to settlement patterns, migration flows or economic indicators.

Their fictional character places limits on the conclusions that can be drawn from them. They do not establish that any scenario will occur, nor do they provide evidence of how future populations will behave.

They do, however, expose questions that institutional analysis must address.

Can essential services remain accessible when people move or when they cannot move? Who bears responsibility when institutions operate across different jurisdictions? How are shared resources allocated between established users and newcomers? What forms of participation are available to people whose contributions are recognised but whose membership remains uncertain?

These questions remain relevant regardless of which future develops. They also return TEOS 2100 to its central concern.

The future of human settlement is not solely a question of where people will live. It concerns the conditions under which they can maintain livelihoods, relationships and rights as the places around them change.

A Post-Settlement Civilisation, if such a development emerges, would therefore require more than the capacity to relocate populations or operate infrastructure across geographical boundaries.

It would require institutions capable of supporting people whose lives are no longer organised around a single permanent location, while also protecting those who wish or need to remain.

The challenge is not to replace settlement with movement. It is to ensure that changing relationships between people and places do not determine who can live securely, exercise rights or belong to a community.

8. From Nomads to the Stars

"The cosmos is within us. We are made of star-stuff.
We are a way for the universe to know itself."

Carl Sagan

8.1 Why Long-Term Futures Matter

TEOS 2100 began with the changing water systems of the Hindu Kush Himalaya. It examined the consequences of glacier retreat, shifting river flows and growing pressures on the settlements that depend on them. From there, the analysis moved towards a wider question: how might human societies organise themselves when the places in which people live can no longer be assumed to provide lasting security?

The year 2100 offers a horizon within which to explore this question. It is sufficiently distant for substantial environmental, demographic and institutional changes to become conceivable, yet close enough for decisions made today to influence the conditions under which future generations will live.

This horizon does not provide certainty. Climate projections can describe possible physical changes under different assumptions, but the social and political responses to those changes remain much harder to anticipate. Institutions may adapt before conditions become critical. Communities may invest in new forms of infrastructure or develop arrangements for sharing resources. Governments may cooperate across borders, or they may respond by restricting access to territory and public services.

These choices matter because environmental pressures rarely operate in isolation. Changes in water availability can affect agriculture, energy production and local employment. Economic losses may influence household decisions about migration. Population movements can alter demand for housing, education and healthcare in receiving regions. Where existing institutions cannot accommodate these developments, environmental pressures may become political and social conflicts.

Long-term foresight helps us examine these relationships without treating any single outcome as inevitable.

The four scenarios developed in Chapter 6 illustrate different ways in which societies might respond. *Fortress Earth* describes a future in which protection is concentrated in selected territories and access becomes increasingly unequal. *Negotiated Mobility* explores the possibilities and limitations of formal agreements that allow people to move while retaining recognised rights. *Networked Nomads* considers a highly connected economy in which mobility is facilitated by private networks, but social protection and democratic accountability remain uneven. *Planetary Transition* examines more coordinated forms of adaptation, including efforts to preserve viable settlements and manage shared resources.

These scenarios do not represent stages through which humanity must pass. They are alternative futures intended to expose the consequences of different institutional choices.

The Human Stories in Chapter 7 demonstrate why those choices cannot be evaluated solely through infrastructure, resource availability or economic indicators. A society may provide reliable water while excluding neighbouring communities from access. It may recognise professional qualifications without enabling qualified people to work. It may allow people to relocate while offering them little influence over decisions in their new place of residence.

Equally, arrangements for cooperation can create opportunities while leaving difficult questions unresolved. The Water Assembly in Chitral, for example, demonstrates how a community might manage competing claims on limited resources. Yet the same institution must also determine how newcomers can gain access and participate in collective decisions.

These situations point towards a broader understanding of adaptability. The capacity of a society to respond to environmental change depends partly on its infrastructure and material resources. It also depends on whether people can maintain livelihoods, access essential services, preserve relationships and exercise political rights as their circumstances change.

For some, adaptation will involve relocation. Others may move regularly between several places. Many will continue to live in established communities, even as the conditions supporting those communities change.

A long-term perspective must accommodate all three possibilities. It should also recognise that mobility is neither an entirely new condition nor an automatic indication of progress. Human societies have long included pastoral communities, travelling traders, seasonal workers and populations maintaining relationships across political boundaries. Their experiences demonstrate different ways of organising social life, although they cannot simply be transferred to the environmental and institutional conditions of 2100.

What may change is the scale and character of the relationship between mobility and settlement. Modern states, public services and economic institutions frequently rely on stable residence. Schools, healthcare systems, employment regulations, taxation and political representation are organised largely through territorial jurisdictions. These arrangements have evolved in different ways, and many already accommodate movement across borders.

Yet extensive or prolonged mobility could place greater demands on their ability to provide continuity. If a person moves between several jurisdictions, which authority is responsible for ensuring access to healthcare? How can professional qualifications and social security entitlements remain valid? What happens to political representation when citizenship, residence and the location of economic activity no longer coincide?

Chapter 5 examined these questions as matters of institutional design. Their relevance extends beyond climate-related migration. They concern the broader capacity of human societies to organise cooperation across distance and changing environments. This provides a reason to consider developments beyond the immediate geographical and temporal boundaries of TEOS 2100.

Current efforts to extend human activity in Earth orbit, on the Moon and, potentially, towards Mars introduce another setting in which people may become increasingly dependent on

institutions capable of operating across distance. Such activities differ fundamentally from migration within the Earth system. Their technical requirements are more demanding, and their economic and political conditions remain uncertain.

Nevertheless, they raise some familiar questions. How can essential services remain reliable when supplies are limited? Who is responsible for maintaining shared infrastructure? How are disagreements resolved when people cannot easily leave their environment? What political rights should individuals possess when they live in facilities operated by organisations or states located elsewhere?

These questions do not make a mobile community in the Hindu Kush Himalaya equivalent to a crew aboard a spacecraft. Nor do they imply that terrestrial adaptation will lead to the settlement of other worlds. The connection is more limited and more useful. Both situations require societies to consider how continuity, cooperation and individual rights can be maintained when established relationships between people, infrastructure and territory are altered.

There is also an important difference. A spacecraft, orbital habitat or lunar facility is an intensely place-dependent environment. Its inhabitants rely on the integrity of a specific technical system, even if their personal and professional lives extend between Earth and other locations. Such environments therefore combine geographical mobility with forms of physical dependence that are more restrictive than those experienced in most terrestrial settlements.

This distinction cautions against treating space settlement as the ultimate expression of nomadism. The value of looking beyond Earth lies instead in examining the institutional requirements of human life under unfamiliar conditions.

A civilisation capable of maintaining people in remote or isolated environments would need more than advanced engineering. It would need arrangements for allocating resources, organising work, protecting health, resolving conflicts and ensuring accountability. How such arrangements develop would depend on political and social decisions, not solely on technological capability.

For TEOS 2100, this wider perspective does not change the focus of the report. The Hindu Kush Himalaya remains the geographical starting point, and the future of human settlement on Earth remains its central concern. The purpose of Chapter 8 is to examine what the preceding analysis tells us about the longer development of human societies.

The first question is whether mobility can be organised as a durable social capability rather than treated primarily as a response to emergency. The second concerns the institutions needed to maintain rights and responsibilities when people are no longer bound to a single place. The third asks what these experiences may contribute to thinking about human life in environments beyond Earth.

None of these questions requires the assumption that permanent settlement will disappear. Humanity may continue to depend on settlements for most of its activities while developing more flexible ways of connecting people, resources and institutions across them.

What matters is whether these arrangements expand people's ability to live securely and participate in society, or whether they create new forms of exclusion and dependence. The long-term future of settlement is therefore inseparable from the future of governance. The ability to move, the ability to remain and the ability to belong will depend on the institutions societies choose to develop.

That is the wider civilisational question with which TEOS 2100 concludes.

8.2 Mobility as a Civilisational Capability

Mobility has often been understood as a response to circumstances that make remaining in one place difficult. People leave their homes because employment opportunities disappear, environmental conditions deteriorate, political conflicts escalate or personal circumstances change. In such situations, movement may provide access to safety and new opportunities. It may also involve the loss of familiar surroundings, established livelihoods and social relationships.

This understanding captures an important part of human mobility, but it does not explain the full range of ways in which movement contributes to social and economic life.

People have travelled, migrated and maintained relationships across considerable distances throughout human history. Pastoral communities have organised their livelihoods around seasonal movement. Traders have connected distant markets, while families have maintained relationships between places over several generations. More recently, international employment, education and digital communication have made it possible for some people to organise their lives across multiple locations.

These practices differ substantially in their purposes, conditions and consequences. They nevertheless demonstrate that permanent residence in a single place is not the only basis on which people organise their lives. The question for TEOS 2100 is how societies might maintain social and institutional continuity if mobility becomes more significant under changing environmental conditions.

Mobility can be understood as a civilisational capability when people and institutions possess the means to organise movement without repeatedly losing access to the conditions necessary for a secure life.

This capability involves more than the availability of transport. A person may be physically able to cross a border while remaining unable to work legally in the receiving country. A family may relocate successfully but lose access to education or healthcare. A qualified professional may find employment in several jurisdictions without being able to maintain social insurance or retirement entitlements.

Movement in itself does not resolve these difficulties. The capacity to live across different locations depends on the institutions that recognise people, protect their rights and provide continuity as their circumstances change.

Mobility requires institutional continuity

Many contemporary systems of public administration are organised around residence.

Children attend schools assigned to particular districts. Healthcare providers maintain records within national or regional systems. Social benefits depend on eligibility requirements that frequently include residence or employment status. Political representation is linked to citizenship, electoral districts and established procedures for determining who may participate.

These arrangements provide administrative clarity and allow governments to allocate responsibilities. They can also create difficulties for people whose lives extend across several locations.

A family moving repeatedly between regions may encounter different school curricula and qualification requirements. A patient receiving treatment in more than one country may face obstacles in transferring medical information. A worker employed through several temporary contracts may accumulate entitlements that cannot easily be combined.

Such problems already occur. Their significance could increase if environmental pressures contribute to more extensive, prolonged or repeated movement. The institutional response need not involve replacing established public systems. It may instead require greater continuity between them.

Education records can be recognised across administrative boundaries. Qualifications can be assessed through agreed procedures. Social protection arrangements can coordinate entitlements accumulated in different jurisdictions. Healthcare providers can exchange relevant information under appropriate safeguards.

These measures are sometimes described as the portability of rights and services. Yet portability should not be confused with unrestricted access. A recognised educational qualification does not automatically guarantee admission to an institution. A transferable medical record does not establish an entitlement to treatment. A digital identity does not create residence or employment rights where those rights are absent.

Technical compatibility must therefore be accompanied by legal recognition, clear responsibilities and accessible procedures for resolving disputes. For TEOS 2100, institutional continuity is a condition that may allow mobility to become a viable adaptation option rather than a recurring disruption.

The ability to remain

Mobility as a civilisational capability also includes the freedom not to move. The effects of environmental change differ between locations and households. Some communities may remain viable through investments in water management, agricultural adaptation or protective infrastructure. Others may face conditions that eventually make relocation necessary.

Individual circumstances also influence whether movement is possible or desirable. Older people may depend on established care arrangements. Families may maintain livelihoods connected to land or local resources. Children may benefit from continuity in education and social relationships. Cultural and personal attachments may influence decisions even where economic opportunities exist elsewhere.

A society that treats movement as the preferred response to environmental pressure risks overlooking these circumstances. People may experience substantial losses when they are required to relocate, even if new housing and employment opportunities are available. Conversely, remaining in an increasingly hazardous location may expose households to risks that they cannot manage independently.

The relevant issue is therefore the availability of meaningful choices. Policies should support adaptation where continued habitation is viable, while creating safe and accessible pathways for relocation where remaining becomes untenable. These alternatives may need to coexist over extended periods.

Some households may move permanently. Others may relocate seasonally or maintain members in different locations. Communities may also develop shared arrangements that allow people to move temporarily without severing their connection to places of origin. Mobility becomes a broader societal capability when institutions can accommodate this diversity rather than requiring everyone to follow a single pattern of settlement or movement.

Livelihoods across locations

Employment is a central factor in the viability of mobile lives. People who relocate need opportunities to earn an income, maintain professional qualifications and participate in economic activity. Some occupations can be performed remotely. Others require physical presence, local knowledge, access to land or specialised equipment. Agriculture, construction, healthcare, education and infrastructure maintenance cannot be reorganised entirely around digital work.

Nevertheless, these occupations may include forms of temporary, seasonal or distributed employment. A technician may work on infrastructure across several districts. A healthcare professional may serve multiple communities through a regional network. Agricultural workers may combine activities in different locations according to seasonal conditions. The organisation of such work requires attention to contractual rights, working conditions and access to social protection.

Digital platforms can facilitate the matching of workers with assignments, but they can also create dependence on private systems controlling access to employment. The Networked Nomads scenario examined these tensions. The experiences of Amara and Nasrin in Chapter 7 illustrate how employment opportunities can become insecure when access to work depends on platform rules or continuous availability. Their stories also demonstrate that flexibility is distributed unequally.

People with recognised qualifications, reliable connectivity and sufficient financial reserves may be better able to benefit from mobile work than those facing care responsibilities, limited resources or restricted legal status. Mobility should therefore not be evaluated only by the number of people able to work across borders. The more relevant question is whether employment arrangements provide a secure basis for maintaining livelihoods and social participation.

Access to water, food and energy

The physical requirements of everyday life remain central to mobile societies. People need reliable water, adequate nutrition, energy, sanitation and shelter wherever they live. Movement may alter how these needs are met, but it does not reduce their significance. Established settlements commonly depend on infrastructure networks developed over long periods. Mobile populations may need to access these networks temporarily or rely on smaller, decentralised systems.

Chapter 5 examined technologies that could support such arrangements. Modular water treatment, distributed energy systems, local storage and adaptable housing may improve the capacity of communities to respond to changing conditions. Food production presents further possibilities and constraints. Mobile greenhouses, modular cultivation systems, controlled-environment agriculture and small-scale processing facilities could supplement existing supply arrangements in some circumstances.

Their usefulness would depend on resource availability, technical maintenance, transport requirements and economic feasibility. Such systems would not necessarily replace established agriculture or eliminate dependence on regional food networks. In many cases, reliable connections between producing regions and receiving communities would remain more efficient than attempting to make every mobile group self-sufficient.

A distinction is therefore required between decentralised capacity and complete independence. A mobile community may benefit from the ability to store water, produce some food or generate electricity locally. However, these capabilities do not remove the need for wider systems of production, exchange and cooperation. The management of limited resources also involves political decisions.

Where water or energy is scarce, access must be allocated between competing uses. Technical improvements can reduce losses, but they cannot independently determine which claims should receive priority. The Water Assembly in Chapter 7 illustrates this problem.

The community possesses monitoring equipment, irrigation infrastructure and agreed procedures for allocating water. Its members must nevertheless decide how to distribute a limited resource between established users, essential food production and people seeking to enter the cooperative. The ability to maintain viable living conditions therefore depends on institutional arrangements as much as engineering.

Learning and healthcare across distance

Education and healthcare are closely connected to the continuity of mobile lives. Children who move between regions require opportunities to continue their education without repeatedly restarting or losing recognition for previous learning. Adults may need to acquire new qualifications as employment opportunities and local economic conditions change.

Digital technologies can improve access to learning materials, but they cannot resolve every difficulty associated with mobile education. Language, curriculum differences, assessment procedures and the availability of teachers remain relevant. Children also need relationships with peers and educators. Educational continuity involves more than maintaining access to a

digital platform. Mobile arrangements may therefore require combinations of local learning centres, recognised curricula, remote support and coordination between institutions.

Healthcare presents similar challenges. Patients need continuity in diagnosis, treatment and access to medication. Medical professionals require reliable information about previous care, while health systems must determine who is responsible for financing services. Digital records can support coordination, provided privacy and data protection are maintained. Yet the availability of records does not guarantee access to treatment.

Healthcare also involves activities that cannot be performed remotely, including physical examinations, emergency interventions and many forms of personal care. The experiences of Nasrin and her father Abdul in Chapter 7 draw attention to another issue. Mobility-oriented systems may assume that people can respond to work opportunities by changing their location. For individuals providing continuous care to dependent relatives, that assumption may be unrealistic.

A society capable of accommodating movement must also recognise responsibilities that require people to remain present. The ability to maintain education and healthcare across locations is therefore inseparable from the provision of local services and support for care.

Cultural knowledge and social relationships

Institutional arrangements alone cannot ensure that mobility produces positive social outcomes. People moving between regions encounter different languages, customs and expectations. Receiving communities may face changes in demand for housing, public services and employment. Established residents may worry about the distribution of resources or the preservation of cultural practices. Newcomers may encounter discrimination or difficulties obtaining recognition for their skills and contributions.

These tensions cannot be addressed through transport infrastructure or administrative coordination alone. They require opportunities for communication, participation and the resolution of disagreements. Existing regional integration arrangements provide useful experience. Within the European Union, freedom of movement and associated legal frameworks have enabled many people to study, work and live in another member state under recognised conditions.

These arrangements have developed over decades through treaties, legislation and judicial decisions. They have not eliminated political disputes concerning migration, labour markets or social protection. Their relevance lies in showing that cross-border mobility can be supported by institutions that extend beyond individual national administrations. For TEOS 2100, such experiences suggest possible approaches rather than models that can simply be transferred to other regions.

The Hindu Kush Himalaya includes countries with different political systems, economic capacities and historical relationships. Any arrangements for sustained regional mobility would need to reflect those conditions. Cultural adaptability also operates in both directions. People arriving in a community may need to learn its language and understand local practices. Established residents may need to reconsider rules that exclude newcomers who contribute to shared economic and social life.

This is visible in the relationship between Haroon, Rahmat and Daniyal in Chapter 7. Haroon's technical work is valued by the water cooperative, yet his participation in decisions about land and irrigation remains uncertain. The question is not whether the community should abandon its existing institutions. It is whether those institutions can recognise new forms of contribution and membership without disregarding established responsibilities or ecological limits.

Political participation as a condition of mobility

The capacity to move while maintaining access to services is insufficient if people lose their ability to influence decisions affecting their lives. Chapter 5.1 examined the relationship between citizenship, residence and affectedness. These relationships can become increasingly distinct where people maintain lives across several jurisdictions.

Someone may retain voting rights in a country of nationality while having little influence over municipal decisions in the place where they live. A mobile worker may contribute to the economy of a region without acquiring the political rights associated with long-term residence. A community may depend on water or infrastructure managed by authorities outside its territorial jurisdiction. Such arrangements raise questions about democratic legitimacy.

Political participation must therefore be considered alongside the portability of economic and social rights. Existing procedures for voting from abroad, local consultation and participation in resource governance offer starting points. However, their effectiveness depends on legal recognition and practical accessibility.

Digital methods may allow people to participate from distant locations, but they also require safeguards against exclusion, surveillance and manipulation. More fundamentally, institutions must determine whose interests are represented and who has the authority to make binding decisions. A mobile society cannot become politically viable merely by developing systems capable of administering people across borders. It also needs procedures through which those people can exercise political agency.

This requirement applies equally to established residents and newcomers. Where populations share limited resources, conflicts over participation may become inseparable from conflicts over allocation. Mobility as a civilisational capability must therefore include the capacity to negotiate membership, responsibility and representation.

Dependence and resilience

Mobility can increase the range of options available to individuals and communities. A household with access to employment in several locations may be less dependent on a single local economy. A region connected to diverse supply networks may be better able to withstand disruptions affecting individual routes or production centres.

However, expanded connectivity can also create new dependencies. A mobile worker may rely on a single digital platform. A community may depend on specialised equipment that cannot be repaired locally. A household may maintain access to services only while a

particular residence or employment agreement remains valid. The ability to move does not necessarily make these arrangements resilient.

Resilience depends partly on whether alternatives exist when one system fails. This may involve technical redundancy, diversified supply arrangements or the ability to obtain support from different institutions. It may also require legal procedures for challenging decisions and mechanisms for maintaining essential services during interruptions.

For TEOS 2100, a society with extensive mobility but weak institutional protection cannot be considered adaptable solely because people are able to change location. Its capacity to manage disruption must be examined through the security and continuity of the lives it supports.

From individual mobility to civilisational capacity

The distinction between individual movement and collective capability becomes clearer when considered across generations. A person may learn to travel between unfamiliar places, communicate across cultural boundaries and adapt to changing working conditions. These are individual experiences and abilities.

A society develops a broader capability when its institutions allow such experiences to occur without requiring people to repeatedly reconstruct their legal identity, professional standing or access to essential services. That capability depends on public administration, infrastructure, social relationships and political accountability.

It must also remain accessible to people who cannot move freely. The elderly, children, people with disabilities and individuals providing care may experience mobility differently from those able to relocate for employment. A society that accommodates only the most mobile members of its population has not developed a capability available to everyone.

This distinction matters for the future imagined in TEOS 2100. A Post-Settlement Civilisation would not be defined by the disappearance of permanent settlements or by continuous movement. It would be characterised by institutions capable of maintaining social continuity under more varied relationships between people and places.

Such a civilisation could include established cities, adapted rural communities, seasonal settlements and populations maintaining lives across several regions. Its capacity would lie in connecting these arrangements while protecting rights and providing opportunities for participation.

Implications for longer-term human development

The institutional requirements described in this chapter also raise questions extending beyond the environmental conditions of the Hindu Kush Himalaya. Human activities in remote research facilities, isolated communities and space missions already depend on coordination across distance.

The practical requirements differ, but some institutional concerns are shared. People need access to reliable services, clearly assigned responsibilities and procedures for resolving

disagreements. They must be able to cooperate under constraints and maintain relationships with communities elsewhere.

The relevance of these experiences does not imply a direct progression from mobile societies on Earth to permanent human settlement beyond it. Space environments involve technical and biological constraints that cannot be resolved through social organisation alone. Nevertheless, the development of institutions capable of maintaining human lives across multiple locations may provide useful experience for considering more distant futures.

For TEOS 2100, the immediate implication remains terrestrial. The ability to move and the ability to remain should not be treated as opposing political objectives. Both depend on societies capable of adapting their institutions to changing circumstances. The measure of mobility as a civilisational capability is therefore not how far or how frequently people travel.

It is whether movement, when necessary or desired, can take place without the repeated loss of security, rights and participation. And it is whether those who remain can continue to live under conditions that allow them to make meaningful decisions about their own future.

8.3 From Forced Movement to Designed Mobility

People rarely leave their homes because of environmental change alone. Decisions about movement are shaped by employment, family relationships, public services, political conditions and the resources available to individual households. Environmental pressures can influence all these factors, sometimes gradually and sometimes through events that leave little time for preparation.

A flood may destroy housing within hours. Repeated crop failures may make farming economically unsustainable over several years. A village may remain physically accessible while its water supply, healthcare facilities or transport connections become increasingly unreliable. In each case, the question of whether people can continue living in a particular place involves more than the condition of the land itself.

It also depends on whether public institutions can maintain essential services, whether households possess resources for adaptation and whether alternative livelihoods remain available. These differences matter when considering the relationship between forced displacement and planned mobility.

Forced displacement generally involves movement under conditions in which people have little meaningful choice. It may follow a sudden disaster, emerge from prolonged insecurity or occur when the cumulative effects of environmental and economic pressures make remaining untenable.

Planned mobility begins from another premise. It recognises that some changes in settlement patterns can be anticipated and that institutions may be able to prepare alternatives before people face immediate danger.

The distinction is not always clear in practice. A household may agree to relocate while facing circumstances that make refusal unrealistic. A community may remain in place despite serious risks because its members do not trust the alternatives being offered.

For TEOS 2100, designed mobility should therefore be understood as an approach to public planning rather than a separate category of human movement.

Its purpose is to expand the range of safe and viable choices available to people under changing conditions.

When adaptation becomes displacement

Environmental change affects the viability of settlements through interacting processes. Water scarcity may reduce agricultural production, but its consequences depend on irrigation systems, crop choices, available employment and the capacity of households to absorb losses.

Flooding may damage infrastructure repeatedly without making an entire settlement permanently uninhabitable. In other circumstances, landslides, erosion or the loss of essential water sources may create risks that cannot reasonably be managed through local adaptation.

The transition from adaptation to displacement is therefore rarely associated with a single, universally applicable threshold. Technical assessments can identify hazards and estimate exposure. They can examine the reliability of water supplies, the stability of slopes and the costs of maintaining infrastructure.

They cannot independently determine the social value of remaining in a place. A household may consider continued residence acceptable despite conditions that public authorities regard as increasingly dangerous. Another may wish to relocate long before a settlement reaches a formally recognised risk threshold.

These differences require public institutions to distinguish between environmental assessment and decisions concerning people's lives. Scientific information is necessary for evaluating risks, but decisions about relocation also involve rights, cultural relationships, economic interests and political responsibility.

For communities in the Hindu Kush Himalaya, this distinction may become increasingly relevant as the consequences of glacier retreat interact with local conditions. Some settlements may remain viable through improved water management and infrastructure. Others may require substantial adaptation investments whose costs exceed available public resources.

Where relocation becomes necessary, the process through which that necessity is established will influence its legitimacy.

Planning before an emergency

Emergency responses are essential when disasters threaten human life. Evacuation, temporary shelter, medical assistance and food distribution can prevent immediate harm. However, emergency measures are not designed to provide all the conditions required for long-term social and economic security.

Temporary accommodation may become prolonged residence without adequate infrastructure. Families may remain separated from employment opportunities. Children may experience interruptions in education, while displaced households struggle to obtain secure legal status or compensation for lost property.

These problems can become more difficult when public authorities repeatedly extend short-term arrangements rather than establish durable alternatives. Planning for mobility before a crisis creates opportunities to address some of these difficulties.

Governments can identify areas where environmental pressures may affect long-term settlement viability. They can assess the capacity of receiving regions and examine the infrastructure investments required to accommodate population changes. Local authorities can coordinate housing, water supply, sanitation, education and healthcare with anticipated demand.

Employment programmes and qualification recognition can be considered before relocation rather than after people have arrived. Such measures do not eliminate uncertainty. Environmental conditions may change differently from projections. Households may make decisions that diverge from official expectations. Receiving regions may encounter their own economic or ecological pressures.

Planning must therefore remain adaptable. A relocation programme based on fixed assumptions may become inappropriate if circumstances change. Designed mobility requires procedures for reviewing decisions and adjusting arrangements as new information becomes available.

The right to remain

The ability to relocate should not become an argument for withdrawing support from communities that wish to remain. Public authorities may face difficult choices when maintaining infrastructure in environmentally exposed settlements becomes expensive.

Investments in water systems, roads or protective measures may benefit relatively small populations. Governments may conclude that supporting relocation would cost less than maintaining existing services. Economic comparisons are relevant, but they cannot fully capture the consequences of abandoning a settlement.

Homes may contain the savings of several generations. Agricultural land may support livelihoods that cannot easily be reproduced elsewhere. Communities maintain social relationships, languages and cultural practices connected to particular places. Relocation can alter these relationships even when material living conditions improve.

A policy that treats economic efficiency as sufficient justification for moving people risks disregarding these consequences. The right to remain does not mean that governments must preserve every settlement regardless of danger.

Public authorities have responsibilities to protect life and prevent foreseeable harm. They may need to restrict access to locations where risks become unacceptable. Nevertheless, decisions involving the permanent loss of homes and livelihoods require transparent justification and opportunities for affected people to participate.

Where continued habitation remains viable, adaptation should be considered alongside relocation. Where remaining presents substantial danger, authorities should explain the evidence, the available alternatives and the consequences of different choices.

The objective is not to guarantee that every community can remain permanently in its existing location. It is to prevent relocation from becoming the default response merely because people lack political influence or resources to defend their interests.

Voluntary movement and the limits of consent

Freiwilligkeit is central to the legitimacy of planned mobility, but formal consent does not necessarily establish that a decision was freely made. A household may agree to relocate because financial assistance is available only to those who leave. Residents may accept a proposed destination because they have no realistic access to housing elsewhere. Communities may be asked to approve a relocation plan after the most consequential decisions have already been taken.

Under such conditions, consent can become an administrative requirement rather than an expression of meaningful choice. Designed mobility must therefore consider the circumstances in which agreement is obtained. Affected people need access to reliable information about environmental risks, proposed destinations, financial support and the rights they will retain.

They also need sufficient time to examine alternatives and opportunities to challenge decisions. Participation should begin while options remain open. It is less meaningful when public consultations occur after authorities have selected a destination, negotiated land access and committed funding. The process must also recognise differences within communities.

Households do not share identical interests. Landowners may favour compensation arrangements that offer little security to tenants. Younger residents may welcome new employment opportunities while older people fear losing access to established care networks. Women, people with disabilities and individuals without recognised property rights may encounter obstacles to participation.

A procedure that records the agreement of community representatives cannot automatically establish that every affected individual has been heard. For TEOS 2100, designed mobility therefore requires attention to the distribution of influence within the communities involved.

From relocation sites to viable communities

A relocation programme does not succeed merely because people arrive safely at a new location. Its longer-term effects depend on whether households can establish secure lives there. Housing must be accessible and appropriate to local conditions. Water, sanitation and energy systems must be able to support the additional population. Children need places in schools. Healthcare services require sufficient capacity. Adults need access to employment or other means of maintaining livelihoods.

These requirements are familiar from public planning, but their coordination becomes more demanding when population changes occur rapidly. Relocation can also affect people

already living in receiving communities. Additional demand may increase pressure on housing, land and public infrastructure. Competition over employment or resources may create tensions if investments do not account for established residents.

Planning should therefore consider the receiving community as a whole. A programme that provides services only to newcomers may generate resentment. One that distributes resources without recognising the needs of relocated households may reproduce the insecurity that movement was intended to resolve.

The governance problem is not simply how to transport people. It is how to create conditions under which established residents and newcomers can participate in a functioning community. The Negotiated Mobility scenario examined this question through formal agreements between states.

Asha's family in Chapter 7 can relocate under recognised arrangements, yet the move does not resolve every problem associated with livelihood, family relationships and belonging. Farid, working in a receiving municipality, must translate political commitments into housing and services. Their experiences illustrate why the implementation of mobility agreements depends on institutions operating at local as well as national and international levels.

Livelihoods and the continuity of economic life

Relocation can alter the economic foundations of a household. Agricultural families may lose access to land, irrigation systems and established markets. Workers may find that their qualifications are not recognised in receiving regions. Small businesses can lose customers and suppliers when communities disperse. Compensation for physical assets may address some losses without restoring the income those assets previously generated.

For this reason, livelihood planning should begin before relocation. Authorities and communities can assess employment opportunities, access to vocational education and the feasibility of transferring or adapting existing economic activities. In some circumstances, households may maintain relationships with places of origin while developing new sources of income elsewhere.

Seasonal movement and circular migration can provide alternatives to permanent relocation. These arrangements may allow families to diversify their livelihoods while retaining social and economic connections. However, they are viable only where the legal and practical conditions permit them. A person moving regularly between countries may require recognised employment rights, reliable transport and arrangements for maintaining social protection.

Without these conditions, circular migration may create insecurity rather than resilience. Designed mobility should therefore consider several possible forms of movement rather than assume that relocation involves a permanent transfer from one settlement to another.

Portable rights and public responsibilities

Mobility becomes more secure when people can maintain legal identity and recognised entitlements across locations. Birth certificates, educational records, professional

qualifications and medical information may be essential for accessing public services and employment. Digital systems can assist with transferring such information.

Their effectiveness, however, depends on agreements between the institutions responsible for recognising it. A digital medical record has limited value if the receiving healthcare system cannot provide treatment. A recognised qualification does not guarantee the right to work. Chapter 5 examined the portability of rights and the need to coordinate public responsibilities across jurisdictions.

Designed mobility builds on these requirements. A relocation agreement should establish which authorities are responsible for essential services during the transition and after arrival. Where movement crosses national borders, arrangements may be required concerning residence, employment, family reunification and access to social protection. Where movement occurs within a country, responsibilities may need to be coordinated between regional and municipal administrations.

The process should also address property and inheritance rights, particularly where land or housing in the place of origin becomes inaccessible. These questions cannot be resolved through relocation assistance alone. They require a legal and institutional framework capable of maintaining continuity as people's circumstances change.

Political participation during and after relocation

Relocation affects political membership. People may leave municipalities in which they previously exercised voting rights and enter communities where participation depends on residence requirements or citizenship.

Those moving across borders may retain political rights in their countries of origin while having limited influence over decisions in the receiving country. Even internal relocation can interrupt electoral registration and established forms of local representation. Chapter 5.1 identified citizenship, residence and affectedness as three relationships relevant to political participation under mobile conditions.

Designed mobility must address all three.

- Before relocation, affected people should have opportunities to participate in decisions concerning destinations, compensation and the arrangements under which movement will occur.
- During relocation, they need accessible procedures for raising concerns and challenging administrative decisions.
- After arrival, they should be able to participate in the public processes governing the communities in which they live, subject to the applicable legal framework.

The relationship with the place of origin may also remain relevant. People may retain property, cultural responsibilities or rights connected to land and communal resources. Their participation in decisions concerning those interests may require arrangements extending beyond ordinary residence-based procedures. A society capable of planning movement must therefore consider how political relationships continue, change or come to an end.

Without these provisions, relocation can create a gap between the authorities making decisions and the people affected by them.

The risk of managed displacement

Planning can reduce the harm associated with environmental mobility. It can also become an instrument of exclusion. Governments may use environmental risk assessments to justify removing populations from economically valuable land. Relocation programmes may be designed to limit access to certain regions or concentrate disadvantaged groups in areas with fewer opportunities.

Digital registration systems may facilitate access to services while also enabling extensive monitoring of people who move. These risks do not invalidate planned mobility. They demonstrate why its purposes and procedures require public scrutiny. Transparent risk assessments, independent review and enforceable rights can help distinguish protective relocation from measures primarily serving other interests.

Public authorities should also avoid treating all movement as a problem requiring administrative control. People may relocate for education, employment or family reasons without being subject to a formal adaptation programme. Policies intended to support environmentally affected populations should not unnecessarily restrict these wider forms of mobility.

Designed mobility is most defensible when it expands available options and reduces exposure to harm. It becomes problematic when it substitutes institutional priorities for the choices of the people concerned.

Planning across borders and generations

Environmental pressures rarely correspond to electoral cycles or administrative boundaries. Infrastructure investments may take decades to plan and construct. Changes in agricultural viability can unfold across generations. Relocation may occur gradually as some households move while others remain.

These processes require continuity in public planning beyond individual projects. Governments can develop monitoring systems, establish procedures for evaluating settlement viability and include mobility in regional development strategies. They can also coordinate with neighbouring jurisdictions where population movements or shared resources cross borders.

However, long-term planning should not be confused with a fixed prediction of future population movements. The scale and direction of migration will depend on environmental conditions, economic opportunities and political choices that cannot be established with certainty today. Scenario planning is therefore useful because it allows institutions to examine alternative developments without committing to a single expected outcome.

The four futures in Chapter 6 illustrate how different governance arrangements may shape the consequences of environmental pressures.

- Under *Fortress Earth*, planning may prioritise the protection of selected settlements while restricting access for others.
- *Negotiated Mobility* examines arrangements in which governments cooperate to provide recognised movement pathways.
- *Networked Nomads* considers mobility organised extensively through private economic systems, with uneven public protection.
- *Planetary Transition* explores coordinated adaptation in which relocation remains one option alongside efforts to maintain viable communities.

These differences matter more than any single projection of migration numbers. The central planning question is how institutions respond when environmental conditions and human settlement patterns change.

Designed mobility as an institutional responsibility

Designed mobility should not be understood as a programme for moving populations according to a predetermined geographical plan. Its value lies in preparing institutions for circumstances in which individuals and communities may need or wish to change location. This preparation includes the ability to assess environmental risks, maintain essential services, recognise rights and provide access to viable alternatives. It also requires attention to people who remain in exposed settlements and those already living in receiving regions.

The success of planned mobility cannot be measured solely through the number of people relocated or the speed with which movement occurs. A more useful assessment considers whether people retain security, livelihood opportunities and meaningful participation in decisions affecting their future. Some communities may decide to remain and adapt. Others may relocate together, while individual households pursue different arrangements.

These outcomes need not be uniform. For TEOS 2100, the transition from forced movement to designed mobility is therefore a shift in institutional responsibility. Environmental pressures may make some movement unavoidable. But the conditions under which people move, the choices available to them and the rights they retain are shaped by political decisions.

A society capable of anticipating these needs may reduce the likelihood that environmental change leads to unmanaged displacement. It cannot eliminate every risk or guarantee that all settlements will remain viable. It can, however, create procedures through which people are better able to prepare for change and participate in determining how it affects their lives.

This is the purpose of designed mobility within a possible Post-Settlement Civilisation.

8.4 Post-Settlement Technologies

Technological development has shaped the relationship between human societies and the places they inhabit. Water infrastructure, energy networks, transport systems and communication technologies have allowed settlements to expand and become connected across considerable distances. They have also created dependencies on facilities and services that require continuous maintenance.

As environmental conditions change, some of these systems may need to operate under circumstances for which they were not originally designed. Water supplies may become less predictable. Energy networks may face greater demand for cooling, pumping and treatment. Transport routes may be disrupted, while population movements alter the distribution of demand for housing and public services.

Technological adaptation can help societies respond to these pressures. However, the usefulness of a technology depends on more than its technical performance. Equipment must be affordable, maintainable and appropriate to the conditions in which it operates. People need the knowledge and resources to use it. Institutions must establish responsibilities for ownership, access and maintenance.

For TEOS 2100, post-settlement technologies are therefore understood as systems that can support continuity of human life under changing relationships between people, infrastructure and location. They may serve permanent settlements, temporary accommodation, mobile communities or regions experiencing substantial population changes. Their purpose is not to eliminate the need for established infrastructure. It is to make essential services more adaptable where existing arrangements become insufficient.

Mobile shelter and modular housing

Housing provides protection from environmental conditions and supports everyday social life. It also connects households to water, sanitation, energy and public services. Conventional buildings are generally designed for long periods of use at fixed locations. This remains appropriate in areas where settlements are expected to remain viable. Under changing environmental conditions, however, some communities may require accommodation that can be installed, expanded, adapted or relocated more easily.

Modular construction offers several possibilities. Building components can be manufactured to agreed dimensions, transported to suitable locations and assembled according to local requirements. Units may be combined to accommodate households of different sizes or reorganised as demand changes. Prefabrication can reduce some construction times and improve quality control, although transport requirements and site preparation remain significant.

Modularity also creates opportunities for maintenance. Individual components may be replaced without dismantling entire structures, provided compatible parts remain available. However, relocatable housing should not be confused with permanent housing that can be moved repeatedly without difficulty. Buildings need stable foundations, weather protection, sanitation, ventilation and safe connections to infrastructure. Their performance depends on local conditions.

In the Hindu Kush Himalayan region, terrain presents additional constraints. Narrow roads, unstable slopes and limited construction access can restrict the transport and installation of large prefabricated units. Lightweight structures may be easier to move but can require additional measures for thermal comfort and protection against strong winds. Suitable designs would therefore need to reflect climate, topography, available materials and local building practices.

Housing also has a social dimension. A temporary structure may provide adequate shelter while remaining unsuitable for prolonged family life. Crowded accommodation can affect health, privacy and education. The design of adaptable housing should therefore consider the needs of residents beyond immediate physical protection.

At the institutional level, modular construction does not settle questions of land tenure or access. A household may possess a suitable dwelling but lack permission to occupy a particular site. It may also depend on a private operator for essential connections and maintenance. Technological flexibility must therefore be accompanied by clear arrangements concerning residence, ownership and public responsibilities.

Mobile water systems

Water is essential to the viability of both established settlements and mobile communities. In regions affected by changing river flows, seasonal shortages or infrastructure damage, decentralised treatment and storage may improve the continuity of supply. A range of technologies can contribute to this function.

Filtration and disinfection systems can treat water from suitable local sources. Storage facilities can help manage variations in availability. Monitoring equipment can identify changes in water quality or losses within distribution systems. In some circumstances, treated wastewater can be reused for purposes that do not require drinking-water quality. More extensive recycling may also be technically feasible, depending on treatment standards, energy requirements and monitoring capacity. These possibilities require careful assessment.

Water treatment does not create an unlimited supply. Systems remain dependent on suitable sources or recoverable wastewater, and treatment processes consume energy and require maintenance. Equipment may fail when water contains sediment or contaminants outside its design parameters. Replacement membranes, filters and chemicals may be difficult to obtain in remote locations. Water quality must also be verified independently of whether a system appears to be functioning.

For mobile communities, smaller treatment units may reduce dependence on fixed facilities. They could be deployed during emergencies or used where conventional infrastructure is unavailable. However, their capacity may be insufficient for large populations or water-intensive economic activities. Agriculture, in particular, can require volumes that cannot reasonably be supplied through compact treatment systems alone.

Post-settlement water management must therefore combine technological measures with decisions about demand, allocation and ecological limits. The experience of communal irrigation systems examined in Chapter 7 illustrates this relationship. Monitoring and distribution equipment can provide information and reduce losses. They cannot determine whose water requirements should receive priority. That remains a matter for collective decision-making.

Portable food production

Food security under changing settlement conditions depends on production, storage, distribution and access. Established agricultural systems will remain central to meeting food demand wherever land, water and suitable growing conditions are available. Nevertheless, more flexible food-production systems may supplement conventional agriculture in specific circumstances.

Controlled-environment cultivation can provide greater control over temperature, water application and plant-growing conditions. Modular greenhouses and compact growing units may be useful where suitable agricultural land is limited or seasonal conditions restrict production. Hydroponic and aquaponic systems offer methods of cultivation that can reduce reliance on conventional soil-based production. Their suitability depends on crop type, energy availability, water quality and the capacity to maintain equipment.

Other approaches include local processing, fermentation and the preservation of agricultural products through drying, cooling or controlled storage. Seed banks and regional nurseries may support adaptation by maintaining access to plant varieties suited to changing environmental conditions. These technologies serve different purposes. They should not be treated as interchangeable solutions.

A greenhouse may support vegetable production, while fermentation or local processing can extend the usefulness of available raw materials. Neither necessarily provides the full range of nutrients required by a population. Controlled-environment agriculture can also involve substantial capital costs and energy demand. Where electricity is expensive or unreliable, the economic feasibility of highly controlled production may be limited.

For TEOS 2100, portable food production should therefore be understood as supplementary capacity rather than an assumption of complete self-sufficiency. Its relevance may be greatest where communities need additional food sources during interruptions to supply networks or where cultivation must be adapted to limited space. In many cases, resilient regional food systems will remain more effective than attempting to produce every food locally.

The ability to maintain reliable connections between producers and consumers is therefore as relevant as the development of compact production equipment.

Distributed energy systems

Energy supports nearly every other technological function considered in this chapter. Water treatment requires power for pumping and processing. Healthcare depends on electricity for equipment and refrigeration. Communications, food preservation and many forms of temperature control also require reliable supply.

Distributed generation and storage can provide additional options where conventional networks are exposed to disruption or insufficient capacity. Solar photovoltaic systems, small-scale wind generation, batteries and local distribution networks can support households, public facilities and communities. Microgrids may operate in connection with wider electricity networks or, where technically appropriate, provide local supply during interruptions.

Their value depends on system design and available resources. Solar generation varies with daylight and weather. Wind output depends on local conditions. Batteries provide storage but have finite capacity and require maintenance and eventual replacement. In mountain regions, topography can complicate equipment installation and network connections. Cold temperatures, snow cover and seasonal variations may also affect performance.

A distributed energy system therefore requires assessment of demand, generation potential, storage requirements and technical reliability. For mobile applications, smaller generation and storage units may support communications, lighting, medical equipment or limited water treatment. Larger requirements, including heating, cooling and agricultural production, can place much greater demands on supply.

Energy management is consequently a question of prioritisation as well as generation. When available power is limited, communities may need to determine which services must remain continuously available and which can operate according to demand or supply conditions. These decisions have social consequences.

A system that protects essential medical refrigeration while restricting other consumption may be appropriate during an emergency. Permanent allocation rules, however, require transparent procedures and opportunities for affected users to participate. Distributed energy can improve resilience, but it does not remove the need for governance.

Digital identity and portable records

Digital systems may help people maintain recognised information across changes in residence and employment. Identity documents, educational qualifications, professional certifications and medical records can become difficult to access when individuals move between institutions or jurisdictions.

Secure digital records can reduce some of these difficulties. They may allow authorised organisations to verify qualifications or obtain relevant medical information without requiring individuals to reconstruct their histories each time they move. However, the existence of digital records does not guarantee legal recognition.

A qualification may be authentic but remain insufficient for professional registration in another country. A medical record may be available while the person concerned lacks access to the healthcare system. Portability therefore involves institutional agreements as well as data infrastructure.

The collection and exchange of personal information also create risks. Records concerning identity, health, employment and movement may reveal substantial details about individual lives. Where several systems are connected, the consequences of unauthorised access or improper use can extend across jurisdictions.

Protecting privacy requires more than secure storage. Individuals need information about how their data is used, which institutions can access it and how errors can be corrected. Where services depend on digital verification, alternative procedures may be necessary for people without reliable connectivity or suitable devices.

An identity system should not make access to essential services dependent on continuous participation in one commercial platform. The governance of digital records must also address the division of responsibilities between public authorities and private service providers. For TEOS 2100, the central requirement is that digital systems support the continuity of recognised rights without creating unnecessary surveillance or new forms of exclusion.

Autonomous logistics and mobile production

The movement of equipment, food, medicine and replacement parts is essential to the functioning of geographically distributed communities. Road networks and established transport services will continue to provide much of this capacity. However, difficult terrain, infrastructure damage or temporary changes in population demand may require more flexible arrangements.

Autonomous or remotely operated transport systems could contribute to logistics where their technical and regulatory conditions permit safe operation. Uncrewed aerial vehicles may provide limited transport services in locations where road access is difficult. Small autonomous ground vehicles could support selected tasks within controlled environments.

Their performance depends on weather, terrain, communication systems and the availability of suitable maintenance facilities. Such technologies cannot be assumed to replace conventional transport networks. Payload limits, energy requirements and operating costs may restrict their usefulness.

Mobile workshops and local manufacturing facilities offer another approach. Repair equipment, digital design tools and compact manufacturing systems may allow communities to produce or restore selected components without waiting for deliveries from distant suppliers. This can be relevant where delays in obtaining spare parts threaten essential services. Nevertheless, local manufacturing remains dependent on materials, technical knowledge and quality assurance.

A component produced locally must meet the performance requirements of the equipment in which it will be used. This is critical for medical devices, pressure systems and other safety-relevant infrastructure. The contribution of mobile production therefore lies primarily in reducing selected dependencies and improving repair capacity.

It does not eliminate the need for wider industrial networks. The ability to repair equipment may be more valuable than possessing increasingly complex machinery that cannot be maintained under local conditions.

Communication and governance platforms

Communication systems allow people to maintain relationships, access information and coordinate activities across locations. They also support public administration, education, healthcare and economic exchange. In mobile societies, continuity of communication may become more significant because individuals cannot always rely on institutions located within a single settlement.

Digital platforms could support the exchange of public information, access to services and participation in consultations. They may also help authorities coordinate emergency response and the allocation of resources. However, communication systems should not be treated as substitutes for public institutions. A platform may facilitate applications for residence permits or social benefits, but the legal authority to grant those rights remains with the relevant institutions.

Similarly, a digital voting system can provide a technical method for participation without resolving questions about eligibility, representation or democratic legitimacy. Chapter 5.1 examined the relationship between citizenship, residence and affectedness. These distinctions remain relevant where digital technologies allow people to participate from locations beyond the jurisdiction making a decision. Technical connectivity does not determine whose interests should be represented.

Communication infrastructure must also remain accessible. People may lack devices, reliable electricity or sufficient digital literacy. Others may face language barriers or disabilities that restrict their use of particular systems. Public institutions should therefore retain alternative routes for accessing essential services. The governance of communication platforms also requires accountability for decisions made through automated or commercially operated systems.

A person should be able to challenge an incorrect administrative classification or the suspension of a service on which their livelihood depends. For TEOS 2100, digital governance is useful when it strengthens access, transparency and participation. It becomes problematic when it replaces accountable public decisions with procedures that individuals cannot understand or contest.

Integrating technological systems

The seven technology groups considered above cannot operate independently. Housing requires water, energy and sanitation. Food production may depend on storage, transport and electricity. Healthcare needs reliable supplies, communications and recognised records. A decentralised settlement or mobile community must therefore integrate several systems while maintaining the ability to respond to disruptions.

This creates practical challenges. An interruption in electricity can disable water treatment. A transport failure can delay the delivery of replacement parts. A communications outage may restrict access to remote medical support or administrative services. Such dependencies can produce cascading effects.

Technological resilience depends partly on identifying these relationships and providing appropriate alternatives. Redundancy may be necessary for critical functions. Water can be stored to maintain essential supply during temporary interruptions. Backup electricity may protect medical equipment. Repair capacity can reduce dependence on distant service providers.

However, redundancy has costs. Additional equipment requires materials, investment and maintenance. Communities must determine which functions justify these resources. Integration therefore involves choices about priorities and acceptable risks. These decisions

should be informed by technical assessment, but their consequences extend beyond engineering.

A community may need to choose between expanding productive capacity and improving the reliability of existing essential services. Public accountability matters because technical decisions can affect the distribution of security and opportunity. The most advanced equipment will not necessarily provide the most appropriate solution.

Systems that can be repaired locally, operated with available skills and adapted to changing conditions may offer greater practical value than technologies requiring continuous external support. For TEOS 2100, technological adaptability should therefore be assessed through reliability, accessibility, repairability and the ability to maintain essential functions under disruption.

Resource circularity and material dependence

Technologies designed for mobile or remote applications frequently emphasise efficiency in the use of energy, water and materials. Reducing losses can lower operating costs and improve the reliability of systems where supplies are limited. Water recycling, modular construction, component repair and material recovery can contribute to these objectives.

However, circularity does not mean that material consumption can be eliminated. Equipment wears out. Treatment processes require replacement parts. Energy systems depend on materials that must be produced, transported and eventually recovered or disposed of. Technical systems also lose energy during operation and cannot recycle all materials without additional inputs.

For this reason, circular design should be understood as an effort to reduce resource demand and preserve material value rather than achieve complete physical independence. Durability and repairability are relevant to this objective. Equipment that can be maintained through standard components may remain useful for longer and reduce the need for replacement. Materials should also be selected with consideration of local conditions, availability and environmental consequences.

The development of decentralised systems may create opportunities for using regionally available resources. Yet local production is not automatically environmentally preferable. Its impacts depend on extraction, processing, transport and the energy required.

For TEOS 2100, the relevant question is how resource systems can maintain essential services while reducing the environmental pressures associated with their operation. That question applies to permanent settlements as much as mobile communities.

Technology and unequal access

Technological development can expand opportunities while reinforcing existing inequalities. Communities with sufficient financial resources may install reliable water treatment, distributed energy systems and adaptable housing. Others may depend on ageing infrastructure or services whose maintenance cannot be financed.

Individuals with secure digital identities and recognised qualifications may move between employment opportunities more easily than people whose documentation is incomplete or whose legal status remains uncertain. Private providers may establish services where returns are sufficient while leaving less profitable locations underserved.The uneven distribution of technological capacity could therefore shape future settlement patterns.

- In a *Fortress Earth* scenario, advanced infrastructure may protect selected communities while access remains restricted for others.
- Under *Networked Nomads*, digital systems may facilitate economic activity while making individuals dependent on private platforms.
- *Negotiated Mobility* would require technologies that support recognised cross-border rights and services.
- *Planetary Transition* would place greater emphasis on integrating technical systems with coordinated resource management and public accountability.

The same technology can thus produce different social outcomes depending on how it is governed. TEOS 2100 does not assume that technological progress will automatically produce more equitable access to essential services. The distribution of its benefits remains a political and institutional question.

Beyond Earth: technical similarities and institutional differences

The technologies examined in this chapter have potential relevance beyond terrestrial settlement systems. Long-duration human spaceflight already requires reliable water treatment, waste management, environmental control and closely monitored energy consumption.

A spacecraft or orbital habitat must maintain conditions suitable for human life despite severe constraints on available space, equipment and supplies. Future lunar facilities would face related requirements, although their operating conditions would differ from those in Earth orbit. Plans for more extensive human activities on the Moon and eventual missions to Mars raise further questions concerning local resource use, maintenance and supply dependence.

Some technical approaches overlap with those considered for remote or mobile communities on Earth. Water recycling can reduce the need for resupply. Modular components may support maintenance and expansion. Controlled-environment food production could supplement stored provisions during sufficiently long missions. Local manufacturing may eventually reduce dependence on replacement parts transported from Earth.

However, these similarities should not obscure the differences. Space habitats depend on engineered life-support systems to provide conditions that normally exist within Earth's biosphere. Equipment failure may therefore have consequences that are more immediate and severe than those experienced in most terrestrial settings. Radiation, reduced gravity and the absence of a naturally breathable atmosphere create requirements that have no direct equivalent in ordinary settlement adaptation.

The economic conditions also differ substantially. Transporting equipment and materials beyond Earth involves constraints that can make apparently simple activities technically

complex. It would therefore be misleading to describe terrestrial post-settlement technologies as ready-made solutions for space habitation. The more useful connection lies in the underlying design problems: maintaining essential services, reducing material losses, providing repair capacity and managing interconnected systems under constraints.

There is also a governance dimension. People living in an orbital facility or a future lunar settlement would depend on organisations responsible for infrastructure, supplies and operational rules. Those organisations could include public agencies, commercial providers and international partnerships. Their responsibilities and the rights of inhabitants would need to be established within the applicable legal frameworks.

Technical reliability alone would not settle questions of working conditions, access to services or participation in decisions. This is where the institutional concerns examined throughout TEOS 2100 become relevant to longer-term human activities beyond Earth.

The role of technology in a Post-Settlement Civilisation

Technologies can help maintain essential services when people move, settlements change or existing infrastructure becomes unreliable. They may provide additional flexibility through modular construction, decentralised supply and the coordination of services across locations.

However, they cannot independently establish the conditions under which these systems are accessible or legitimate. A water-treatment unit cannot decide who is entitled to its output. A digital identity system cannot determine whether a person should receive residence rights. A mobile classroom cannot resolve differences in educational recognition between jurisdictions.

These are institutional responsibilities. Technological systems can support their implementation, but the rights and obligations involved must be established through social and political processes. For TEOS 2100, the development of post-settlement technologies should therefore be assessed according to their contribution to the continuity of human life under changing conditions.

This includes physical reliability and efficient resource use. It also includes affordability, accessibility, repairability and the ability of people to exercise meaningful control over systems on which they depend. The long-term significance of these technologies will not be determined solely by the sophistication of individual devices. It will depend on whether societies can integrate them into arrangements that remain functional, accountable and adaptable as relationships between people and places change.

8.5 Governance Beyond Fixed Territory

Territory has long provided a practical foundation for political organisation. States exercise authority within recognised borders, local governments administer defined areas, and public institutions provide services to populations associated with particular jurisdictions. These arrangements make it possible to assign responsibilities, collect revenue and establish procedures for political representation.

They remain relevant under changing environmental conditions.

Even where populations become more mobile, land, infrastructure and natural resources continue to exist in particular places. Housing requires suitable locations. Water systems depend on catchments and distribution networks. Public authorities remain responsible for maintaining roads, schools, hospitals and other facilities within their jurisdictions.

The prospect of a Post-Settlement Civilisation does not make these territorial relationships obsolete. It does, however, raise questions about whether institutions organised primarily around fixed residence can accommodate people whose lives extend across several locations.

A person may retain citizenship in one country, work in another and receive healthcare in a third. A family may maintain property and social relationships in its place of origin while living elsewhere for much of the year. Communities may depend on resources managed by authorities beyond their own territorial boundaries.

Such arrangements already exist. Their administrative and political implications could become more significant if environmental change contributes to sustained mobility across the Hindu Kush Himalayan region and beyond.

Governance beyond fixed territory refers to the institutional capacity to manage these overlapping relationships. It does not require the disappearance of states or the replacement of national sovereignty by a single international authority. Instead, it concerns how responsibilities can remain identifiable, rights enforceable and political decisions legitimate when the people affected by them are not always located within one jurisdiction.

The limits of residence-based administration

Public administration commonly uses residence to determine eligibility for services and the responsibilities of particular authorities. A person's registered address may establish where children attend school, which local administration provides assistance or where certain taxes and contributions are collected. These arrangements simplify the organisation of public services. They also provide a basis for estimating demand and allocating resources.

Problems arise when residence no longer reflects the full circumstances of an individual's life. A family moving between two regions may have continuing responsibilities in both. A worker employed temporarily across a border may contribute to social insurance systems that are difficult to coordinate. A person requiring regular medical treatment may receive care from institutions in several locations.

Where eligibility depends on uninterrupted residence, movement can interrupt access even when the underlying need remains unchanged. Governance beyond fixed territory must therefore address the difference between the location at which a service is provided and the legal or financial responsibility for making it available. These responsibilities do not necessarily need to be transferred to one institution. They may instead be coordinated through agreements, shared administrative standards and procedures for recognising entitlements across jurisdictions.

Such arrangements can preserve territorial administration while reducing the disadvantages associated with movement. Their effectiveness depends on legal clarity. People need to know which institution is responsible for a particular service, what requirements apply and

how an incorrect decision can be challenged.A system that permits mobility but leaves responsibility undefined may transfer administrative burdens to individuals. The result can be a form of insecurity that is difficult to recognise because no single institution considers itself responsible for the entire problem.

Shared responsibilities between origin and receiving regions

Mobility can create continuing relationships between places of origin and receiving communities. A household may relocate while retaining property, family members or economic interests in its former settlement. Its members may continue contributing financially to the community they left. At the same time, the receiving municipality becomes responsible for providing infrastructure and services required for everyday life.

These relationships raise questions concerning the allocation of public responsibilities. A receiving community may need additional housing, school capacity and healthcare facilities. The costs may arise before new residents begin contributing substantially to local revenue.

The place of origin may retain obligations relating to land, property records or social benefits even after residents have moved. Where movement crosses national borders, these questions become more complex. National legislation may assign different responsibilities to citizens and non-citizens. Access to public services may depend on residence permits, employment status or bilateral agreements. Chapter 5 examined legal arrangements that can help coordinate some of these responsibilities.

For the longer-term perspective of TEOS 2100, the central issue is whether such arrangements can become sufficiently reliable to support recurring or permanent mobility. Governments may need agreements that clarify the financing and provision of services during transitions between jurisdictions. Municipal authorities may require resources to prepare for population changes rather than respond after demand exceeds capacity.

The receiving community must also be considered as a political and social entity in its own right. Its existing residents may experience additional pressure on housing, employment or natural resources. Arrangements designed to support newcomers should therefore be accompanied by planning that takes account of the wider community.

This is not simply a question of distributing financial assistance. It involves determining who participates in decisions about investment, service provision and the allocation of scarce resources.

The municipality as a central institution

National governments establish legal frameworks for migration, citizenship and public finance. International agreements may coordinate movement across borders. Yet many consequences of mobility are experienced locally. Municipalities provide or organise services that people encounter in everyday life. They maintain local infrastructure, regulate land use and respond to changes in housing demand.

Their capacity to adapt can therefore influence whether migration becomes a source of opportunity or insecurity. A municipality receiving new residents may need to expand water and sanitation systems before additional housing can be occupied. Schools may require

more teachers or facilities. Healthcare providers may face demand for services that existing arrangements were not designed to accommodate. These requirements involve investment, administration and political decisions.

The municipal perspective also reveals a difficulty in the relationship between international agreements and local implementation. A state may commit to accepting people under a regional mobility arrangement, but the municipality responsible for housing them may have limited influence over the agreement or the resources provided for implementation.

The Human Story of Farid in Chapter 7 illustrates this problem. His municipality is expected to accommodate arriving households under recognised arrangements, yet the practical availability of housing and services depends on financial commitments and infrastructure decisions made elsewhere. The conflict is not necessarily between mobility and settlement. It arises when responsibilities are transferred without a corresponding ability to fulfil them.

Governance beyond fixed territory therefore requires stronger connections between the institutions negotiating mobility arrangements and those responsible for their local consequences. Municipalities need sufficient planning information, administrative authority and financial capacity. They also need opportunities to communicate the concerns of residents and arriving populations to higher levels of government.

Financing public services across mobility systems

The financial organisation of public services is closely connected to territory. Governments collect taxes and contributions under national legislation. Municipal budgets often depend partly on population, property or economic activity within their boundaries. Mobile populations may complicate these relationships. A person may earn income in one jurisdiction while maintaining dependants in another. Social insurance contributions may accumulate in several countries. Public services may be used in locations that receive only a limited share of the associated revenue.

Such arrangements are not inherently unsustainable. Existing systems already coordinate taxation and social protection across borders, although the extent and effectiveness of coordination vary. The challenge is to avoid situations in which institutions providing services lack the resources required to maintain them. For TEOS 2100, the expansion of organised mobility could require financial arrangements that reflect changing patterns of residence and service use.

Receiving municipalities might need access to funding linked to actual demand rather than only historical population figures. Regional agreements could establish responsibilities for particular services or coordinate investment in infrastructure serving several jurisdictions. Where communities depend on shared resources, contributions to their maintenance may also need to be distributed between established users and those benefiting from the system temporarily.

These arrangements would require negotiation. Countries and municipalities differ in economic capacity, fiscal systems and political priorities. They may also disagree about the costs and benefits of mobility. Financial coordination cannot eliminate these differences. It can, however, establish more transparent expectations concerning responsibility.

Without such arrangements, mobility may become economically viable for individuals while transferring substantial costs to institutions that have limited influence over the movement taking place.

Political membership across several places

The organisation of public services is inseparable from political representation. Governments exercise authority over people within their jurisdictions, but the right to participate in political decisions is not always based on residence alone. Citizens may retain electoral rights after moving abroad. Long-term residents who are not citizens may have limited opportunities to vote in the places where they live. People may therefore be subject to decisions made by authorities they cannot directly elect.

Chapter 5.1 examined this problem through three relationships: citizenship, residence and affectedness. Governance beyond fixed territory must consider how these relationships can be accommodated within functioning political institutions. Citizenship provides continuity in political membership when people move. Residence connects individuals to the institutions that organise the communities in which they live. Affectedness draws attention to decisions whose consequences extend beyond the territory or population directly represented by the deciding authority.

These relationships cannot simply be merged into one universal voting system. States retain constitutional responsibilities, and electoral rights are established through domestic and applicable international law. Nevertheless, the growing significance of mobility could require changes in the ways political participation is organised. External voting procedures may need to accommodate larger or more dispersed populations.

Municipalities may develop additional mechanisms for consulting long-term residents who lack full electoral rights. Regional institutions managing shared resources may require procedures through which affected communities can present evidence and challenge decisions. These arrangements differ in their legal authority.

Consultation is not equivalent to representation. Representation does not necessarily confer the power to make binding decisions. The distinction matters because institutions can create the appearance of participation without allowing individuals to influence outcomes. For TEOS 2100, the question is whether people have a meaningful opportunity to participate at the level where decisions affecting their lives are made.

Governance without permanent territorial residence

A more extensive form of mobility could lead to political communities whose members are distributed across several jurisdictions for prolonged periods. These communities might maintain shared cultural institutions, professional associations or arrangements for mutual assistance. They could also establish organisations responsible for coordinating education, services or economic activity.

Such institutions would differ from territorial governments. Their authority could derive from voluntary membership, contractual relationships or agreements with existing public

authorities. They would not automatically possess the sovereign powers of states. However, they might perform functions that are significant to the everyday lives of their members.

The resulting governance problem concerns accountability.

Who can become a member? Who elects or appoints the leadership? How are contributions determined? What happens when members disagree with decisions or wish to leave?

These questions become more consequential when participation in an organisation is necessary to access employment, healthcare or other essential services.

A formally voluntary institution may exercise substantial practical power where meaningful alternatives are unavailable. Governance beyond fixed territory must therefore distinguish between the freedom to join an organisation and the ability to challenge its decisions. Where organisations perform functions resembling public services, their accountability requirements may need to extend beyond ordinary contractual arrangements.

This is relevant to the Networked Nomads scenario. Private networks can support employment across national boundaries while leaving individuals with limited influence over the rules governing participation. The existence of extensive mobility does not by itself produce effective political or institutional representation.

The continued role of sovereign states

The expansion of transnational institutions should not be interpreted as evidence that states will become irrelevant. National governments retain powers that are difficult to reproduce through voluntary networks. They establish and enforce legislation, exercise jurisdiction, maintain public finance and participate in international agreements. They are also responsible for implementing many of the rights on which mobile populations depend.

Even where people maintain lives across several countries, their legal status is shaped by the decisions of states. Governance beyond fixed territory is therefore likely to involve cooperation between sovereign authorities rather than their disappearance. The form of that cooperation may vary. Some arrangements could be bilateral, addressing specific migration routes or service responsibilities. Others may involve regional agreements covering employment, qualifications or social protection.

Environmental cooperation may follow river basins or ecological systems rather than migration routes. Different functions may require different institutional scales. A local water cooperative can make decisions concerning irrigation schedules. It cannot establish international residence rights.

A national government can regulate employment and citizenship. It may be unable to manage the consequences of an upstream water diversion in another country without cooperation. A regional body may coordinate shared interests but lack the authority or resources to implement decisions directly.

Effective governance depends on matching responsibilities to the institutions capable of fulfilling them. This does not mean that every problem requires a new international

organisation. Existing institutions may be adapted through clearer agreements, better coordination and mechanisms for resolving disputes.

Shared ecological systems

Environmental governance provides an example of responsibilities extending beyond political boundaries. River basins, ecosystems and atmospheric processes do not follow national or administrative borders. Decisions taken in one jurisdiction can influence the availability of resources elsewhere.

For the Hindu Kush Himalayan region, this is relevant to water management. Changes in upstream storage, withdrawals or land use can affect downstream communities. The resulting relationships may involve local authorities, national governments and regional institutions.

Territorial jurisdiction remains the basis on which many decisions are made, but their consequences extend across borders. Governance arrangements must therefore provide ways to recognise and address those consequences. International legal principles concerning shared watercourses already offer frameworks for cooperation.

However, such frameworks do not automatically ensure that all affected communities can participate in decisions. Regional cooperation requires administrative capacity, reliable information and procedures for negotiation. It may also require arrangements for dealing with disagreements about scientific assessments or the distribution of benefits and risks.

The broader relevance to TEOS 2100 lies in the relationship between ecological systems and political membership. A community may depend on a resource without possessing authority over the place where that resource is managed. As environmental pressures increase, this separation could become more significant.

Governance beyond fixed territory must therefore address relationships created by shared dependence, even when the people involved do not share citizenship or residence.

Membership and the management of common resources

The Planetary Transition scenario examines forms of adaptation in which communities coordinate resource management and maintain viable livelihoods under environmental constraints. Such arrangements may draw on existing traditions of collective resource governance.

However, established rules often depend on residence, property ownership or inherited membership. Population changes can bring these rules into question. People who return to a community may seek to recover earlier rights. New residents may contribute economically without possessing established claims on resources. Younger generations may wish to enter occupations or activities for which access is already allocated.

The Water Assembly in Chapter 7 illustrates these tensions. Rahmat and Daniyal participate in decisions concerning irrigation reductions. Their community must balance the needs of established farmers against the limits of the catchment. Haroon presents a different claim.

He has contributed to maintaining the irrigation system but does not possess the membership status required to receive a water allocation.

His situation raises a question that is relevant beyond agriculture. When people contribute to the functioning of a community, under what conditions should they acquire the right to participate in its decisions? Contribution alone cannot automatically determine access to every resource. A water system has physical limits, and existing users may possess legitimate rights established over generations.

Yet rules based exclusively on inheritance or permanent residence may exclude people whose livelihoods and responsibilities have become part of the community. Institutions must therefore negotiate continuity and change.

Their legitimacy depends partly on whether these negotiations are transparent and whether affected people can participate. This is one reason governance beyond fixed territory cannot be reduced to administrative efficiency. It must also address the political definition of belonging.

Accountability across institutional networks

As responsibilities become distributed across different institutions, it may become harder to identify who is accountable for particular decisions. A municipality may depend on national funding. A regional mobility programme may require implementation by several authorities. A private platform may provide services under contract with a public institution.

When a problem occurs, each organisation may refer responsibility to another. Individuals can then face lengthy procedures without obtaining an effective remedy. Governance beyond fixed territory requires arrangements that prevent responsibilities from disappearing between institutions. Agreements should identify which authority is responsible for specific functions.

People need accessible information about where decisions are made and how they can be challenged. Dispute-resolution procedures must be available to individuals as well as organisations. Independent oversight may be necessary where institutions exercise substantial authority over access to essential services.

This becomes more relevant when administrative systems are digitally connected. A decision recorded in one system may influence eligibility in several others. An incorrect classification could restrict access to employment, residence or public support across multiple jurisdictions. The ability to correct information and challenge decisions is therefore essential to maintaining effective rights.

Technical interoperability should not be mistaken for institutional accountability. The fact that organisations can exchange data does not establish which one is responsible for the consequences.

Conflict resolution across jurisdictions

Mobility can create disputes involving several authorities or legal systems. A worker may challenge the termination of a contract issued through a platform operating abroad. A family

may disagree with the interpretation of a relocation agreement. A community may contest an allocation of water determined through a regional institution.

The mechanisms required to address these disputes differ according to the parties and legal relationships involved. Some can be resolved through domestic administrative review or courts. Others may require mediation, bilateral procedures or institutions established under international agreements. The relevant issue is whether disputes can be addressed without requiring individuals to navigate several disconnected systems.

For people with limited resources, formal access to multiple procedures may provide little effective protection if those procedures are difficult to use. Language, distance, cost and unfamiliar administrative requirements can become significant barriers. Governance arrangements should therefore consider practical accessibility as well as legal jurisdiction.

Where responsibilities are shared, procedures for dispute resolution should be established before conflicts arise. This does not guarantee agreement. However, it can reduce uncertainty about how competing claims will be considered. The long-term viability of mobile societies depends partly on whether disagreements can be managed without threatening the continuity of essential services or legal status.

A governance architecture for mobile societies

The analysis suggests that a Post-Settlement Civilisation would require governance operating across several connected levels.

Local institutions would remain responsible for many matters involving land, infrastructure and community services. National governments would continue exercising sovereignty and maintaining legal frameworks for citizenship, public finance and political rights. Regional agreements could coordinate movement, shared resources and the recognition of entitlements across borders. International institutions would provide forums for cooperation and the development of legal principles. Transnational organisations and private networks might perform additional functions, subject to applicable law and appropriate accountability requirements.

These levels would not form a single administrative hierarchy. Their relationships would depend on the responsibilities involved and the agreements through which authority is exercised. The result could resemble a polycentric system in which several institutions make decisions within overlapping spheres of responsibility.

Such arrangements offer possibilities for adapting governance to different circumstances. They also create risks of fragmentation, unequal institutional capacity and unclear accountability. Their effectiveness would depend on the ability to coordinate responsibilities while maintaining meaningful opportunities for political participation.

For TEOS 2100, governance beyond fixed territory is therefore an institutional capacity rather than a predetermined form of government. Its purpose is to preserve continuity and accountability as people and resources become connected across changing locations.

Implications for the longer-term future

The relationship between territory and governance will remain important throughout the period examined by TEOS 2100. Most people may continue to live in established settlements, and states are likely to retain substantial authority over the conditions of everyday life. Nevertheless, greater mobility and environmental interdependence could make governance arrangements based exclusively on fixed residence less adequate for some populations.

The implications extend beyond migration policy. They concern the ability of people to maintain recognised rights, participate in decisions and receive essential services when responsibilities are divided between institutions. They also concern the capacity of communities to accommodate newcomers and manage shared resources without disregarding established interests.

These problems cannot be resolved through technology alone. Digital identities and interoperable records may improve administrative continuity, but they do not determine political membership or allocate responsibility. Similarly, regional agreements may establish rights without ensuring that local authorities possess the resources required for implementation.

Governance beyond fixed territory therefore requires legal arrangements, administrative capacity and democratic accountability to develop together. The wider significance of this capacity becomes apparent when considering human activities in environments beyond Earth.

A person living aboard an orbital facility or at a future lunar station would depend on infrastructure located far from many of the institutions responsible for its operation. The facility itself would occupy a defined physical location, but decisions concerning financing, technical standards, employment and public authority could involve organisations in several jurisdictions.

Existing space law already provides rules concerning state responsibility and jurisdiction over registered space objects. It does not establish a complete political system for hypothetical permanent settlements beyond Earth. Long-term habitation would therefore raise further questions about representation, responsibilities and the relationship between residents and the organisations controlling essential infrastructure.

These questions differ substantially from the governance of climate-related mobility on Earth. Yet both reveal the limits of assuming that physical location, institutional authority and political membership will always coincide. For TEOS 2100, this is the central implication of governance beyond fixed territory.

Future societies may need to organise responsibility across multiple places while preserving the ability of people to participate in decisions affecting their lives. Territory will continue to matter. The challenge is to ensure that political rights and institutional accountability do not end where established territorial arrangements become insufficient.

8.6 Planetary Boundaries and Human Expansion

Human societies have expanded their geographical reach over thousands of years. Agriculture, trade, infrastructure and technological development have enabled people to inhabit environments that would otherwise support only limited forms of settlement. Water has been transported across considerable distances, buildings have been adapted to extreme temperatures, and transport networks have connected regions with different resources and climatic conditions.

This expansion has never removed the physical requirements of human life. Settlements depend on water, energy, food, materials and functioning ecosystems. Technologies can change the ways these resources are obtained and used, but they cannot eliminate material and energy requirements. For TEOS 2100, this distinction becomes relevant when considering the possible redistribution of human populations under changing environmental conditions.

Some regions may become increasingly difficult to inhabit. Others may experience environmental changes that create new opportunities for agriculture, infrastructure or economic activity. However, a change in local suitability does not necessarily increase the total capacity of the Earth system to support human activity. It may instead redistribute opportunities and pressures across regions. The long-term future of settlement must therefore be considered within the ecological limits of the planet as a whole.

The planetary boundaries framework

The planetary boundaries framework was developed to identify major Earth-system processes whose stability is relevant to maintaining environmental conditions favourable to human societies. It examines nine interconnected processes, including climate change, biosphere integrity, land-system change, freshwater change, biogeochemical flows, ocean acidification and the introduction of novel entities.

The framework also considers atmospheric aerosol loading and stratospheric ozone depletion. These processes are linked. Changes in one can influence the functioning of others. Land conversion, for example, can reduce biodiversity, alter freshwater cycles and affect the storage of carbon. Agricultural production depends on water and nutrients while also contributing to changes in land systems and biogeochemical flows. A global assessment published in 2023 concluded that six of the nine planetary boundaries had been transgressed.[214]

Subsequent assessments identified a further deterioration. The *Planetary Health Check 2026*, published by the Potsdam Institute for Climate Impact Research in September 2026, concluded that seven of the nine boundaries had been exceeded. The assessment identified climate change, biosphere integrity, land-system change, freshwater change,

[214] Richardson, K., et al. (2023). Earth beyond six of nine planetary boundaries. *Science Advances*, 9(37), eadh2458. https://doi.org/10.1126/sciadv.adh2458

biogeochemical flows, novel entities and ocean acidification as processes operating beyond the assessed safe limits.[215]

These findings do not mean that the Earth has crossed a single threshold beyond which human life becomes impossible. Planetary boundaries are scientifically developed indicators of increasing risks to the stability and resilience of the Earth system. Their transgression indicates that human activities are placing substantial pressure on processes that support the conditions under which societies have developed.

The framework therefore provides a useful perspective for TEOS 2100. It demonstrates why the future of settlement cannot be evaluated solely according to the amount of land that remains physically accessible or technically developable. Human habitation also depends on ecological processes extending far beyond individual settlements.

The changing geography of habitability

Climate change may alter the suitability of different regions for human settlement and economic activity. Temperature, precipitation, soil moisture and the frequency of extreme events influence agriculture, water availability and the conditions under which infrastructure can operate. Their geographical distribution is expected to change during the twenty-first century. Some regions may experience greater heat stress or water scarcity. Others may receive more precipitation or undergo changes in vegetation and growing seasons.

These effects will not be uniform. Regional climatic changes depend on atmospheric circulation, topography, land cover and the pathway of future greenhouse gas emissions. The consequences for human habitation also depend on infrastructure, economic resources and institutional capacity. A region experiencing increased rainfall may remain unsuitable for large-scale settlement if water arrives through intense storms rather than reliable seasonal precipitation.

Higher temperatures can increase evaporation and reduce soil moisture even where annual rainfall rises. Similarly, longer growing seasons may create agricultural opportunities while new pests, heat extremes or changes in water availability introduce additional risks. For TEOS 2100, changes in climatic suitability should therefore be distinguished from changes in the broader viability of settlement.

The first concerns environmental conditions. The second includes the ability of societies to maintain livelihoods, infrastructure and essential services under those conditions. Neither can be assessed through temperature or precipitation alone.

Drylands as possible areas of transformation

The research underlying TEOS 2100 identified major dryland regions as potential areas of future transformation. The Sahara, the Sahel and the Gobi illustrate the geographical scale of this question. These regions differ substantially in climate, ecology, population and economic activity. They should not be treated as a single category of land awaiting future

[215] Caesar, L., Sakschewski, B., et al. (2026). *Planetary Health Check 2026: A Scientific Assessment of the State of the Planet*. Potsdam: Potsdam Institute for Climate Impact Research. https://doi.org/10.48485/pik.2026.25

development. Nor is there a scientific basis for assuming that global warming will make them uniformly wetter or more habitable by 2100.

The Intergovernmental Panel on Climate Change identifies significant regional differences in projected African precipitation. Parts of the eastern Sahel may experience increased monsoon rainfall, while other areas face different trends and substantial uncertainty. Higher temperatures, changing rainfall intensity and increased evaporative demand complicate the consequences for agriculture and water availability.[216]

The possibility of wetter conditions in some dryland regions therefore does not justify treating them as future settlement reserves. Land restoration, improved water management and renewable energy infrastructure may alter what is economically and environmentally feasible in selected areas. However, such interventions require resources and can generate additional ecological pressures.

Restoration may improve soil conditions and vegetation cover without creating the water supply necessary for large populations. Renewable energy projects may generate electricity while competing with other land uses or affecting ecosystems. Agricultural development may require irrigation, infrastructure and changes in land tenure. These activities must be evaluated according to local conditions.

They also raise political questions. Drylands are not necessarily empty or unused. Pastoral communities, farmers and other residents may depend on seasonal access to land and water. Their livelihoods may involve forms of mobility that are poorly represented in conventional land-use classifications.

Development projects that treat such areas as available space can threaten established rights and practices. For TEOS 2100, the transformation of dryland regions therefore presents a governance question as much as an environmental opportunity.

New opportunities do not create unclaimed territory

Changes in environmental conditions may alter the economic value of land. A region previously considered unsuitable for particular crops may become more attractive for cultivation under some climatic conditions. Infrastructure investments may enable economic activities that were previously difficult to maintain.

These changes can increase competition over access. Governments may seek to develop new agricultural or energy-producing areas. Private investors may acquire land or establish infrastructure. Mobile populations may regard the same regions as possible destinations for settlement or employment.

Yet land that appears underused in an economic assessment may already support ecological functions and established livelihoods. The absence of permanent buildings does not establish the absence of legitimate rights. Pastoral migration routes, seasonal grazing

[216] Intergovernmental Panel on Climate Change (2022). *Climate Change 2022: Impacts, Adaptation and Vulnerability*. Working Group II Contribution to the Sixth Assessment Report, Chapter 9: Africa. Cambridge University Press. https://www.ipcc.ch/report/ar6/wg2/chapter/chapter-9/

areas and communal resource systems may depend on access arrangements that are difficult to recognise through conventional property records.

Development can also alter relationships between communities sharing a resource. A new irrigation scheme may benefit agricultural production while reducing water available to downstream users. An energy project may create employment while restricting access to land. These consequences are familiar from existing development processes. Their significance could increase if environmental change alters the attractiveness of different regions.

Governance arrangements would need to address land tenure, resource access and the participation of affected populations. The questions examined in Chapter 5.1 would remain relevant. Who has the right to decide how land is used? Which communities are affected by changes in resource allocation? What opportunities do newcomers and established residents possess to influence development?

The emergence of new economic opportunities does not remove these questions. It may make them more difficult to resolve.

Ecological limits to mobility

Mobility can reduce exposure to local environmental hazards. It may allow households to move away from areas experiencing repeated flooding, declining agricultural production or increasing heat stress. However, movement also requires resources. Transport consumes energy and materials. Housing in receiving locations requires land and infrastructure. Additional demand for water, food and electricity must be accommodated. Where people move from one region to another, some environmental pressures may be reduced while others increase.

A receiving city may provide safer housing but face growing demand for water from an already stressed river basin. A new transport corridor may improve access while fragmenting habitats or increasing land conversion. Decentralised energy and water systems may reduce dependence on existing infrastructure while requiring additional materials and maintenance.

Mobility cannot therefore be regarded as environmentally beneficial solely because it enables people to leave exposed areas. Its consequences depend on the resources required and the conditions in receiving regions. For TEOS 2100, this means that adaptation planning should consider the ecological effects of movement alongside its social and economic benefits. The objective is to reduce vulnerability without transferring disproportionate environmental costs to other communities or ecosystems.

Settlement density and resource demand

The concentration of populations in established settlements can provide efficiencies. Shared infrastructure may reduce the amount of land, material and energy required per person for certain services. Public transport can reduce dependence on individual vehicles. District-scale water and energy systems may support efficient resource management. These advantages depend on planning, technology and the pattern of demand.

High population density can also intensify exposure where infrastructure is inadequate or environmental conditions are unfavourable. Rapid growth may exceed the capacity of water systems, sanitation networks and housing markets. At the same time, dispersed settlement can require extensive transport and infrastructure networks.

No single settlement pattern is inherently the most sustainable under all conditions. A compact city with reliable public services may use resources more efficiently than a dispersed settlement dependent on long journeys. A smaller rural community using local resources may remain viable where the ecological conditions and infrastructure requirements are appropriate.

For TEOS 2100, the future distribution of settlement should therefore be evaluated through the relationship between population, resource demand and environmental capacity. The relevant measure is not simply the number of people living in a particular area. It is whether the systems supporting them can operate without creating unacceptable environmental and social consequences.

Resource efficiency and the limits of circularity

Technological improvements can reduce the resources required to provide particular goods and services. More efficient irrigation can lower water losses. Improved building design can reduce heating and cooling demand. Repairable products can remain useful for longer, while material recovery can reduce the need for some primary resources. These measures are relevant to both permanent and mobile communities.

However, efficiency gains do not automatically reduce total resource consumption. Lower operating costs may encourage increased use. Expanding infrastructure can offset savings achieved through more efficient equipment. Material recovery also involves losses. Products degrade during use, materials become dispersed and recycling processes require energy.

Some resources cannot be recovered economically or technically under existing conditions. Circularity should therefore be understood as a means of reducing primary resource demand and extending material value rather than eliminating dependence on natural systems. This distinction matters when considering the technologies discussed in Chapter 8.4.

A modular dwelling may be easier to repair or relocate, but its construction still requires materials. A portable water-treatment system can improve access to safe water, but it depends on energy, consumables and suitable water sources. Controlled-environment agriculture can reduce some land or water requirements while increasing demand for electricity and technical equipment.

The environmental performance of such systems must be assessed over their operation and life cycle. Technological flexibility alone does not guarantee sustainability.

Energy, materials and the cost of expansion

The development of new settlement areas requires infrastructure. Roads, housing, water networks and energy systems consume materials during construction and maintenance. New production facilities require equipment and supply chains. Even where energy is

generated from renewable sources, the systems involved require materials, land and industrial processes.

The environmental consequences of expansion therefore extend beyond the location where new infrastructure is installed. A settlement may operate with relatively low direct emissions while relying on products whose manufacturing has substantial impacts elsewhere. For TEOS 2100, this raises questions about the geographical distribution of resource consumption.

The apparent sustainability of one community should not depend on ignoring costs transferred to another region. Material extraction, industrial production and waste management may affect populations that have little influence over the location or operation of the facilities concerned.

The governance of expansion must therefore consider supply chains and resource responsibilities beyond individual settlements. This applies to investments intended to support climate adaptation. Projects designed to improve resilience should be examined for their material requirements and environmental consequences.

A protective intervention that substantially increases pressure on other ecological systems may solve a local problem while contributing to wider instability. Long-term planning requires consideration of these relationships.

Ecological restoration and human adaptation

Environmental adaptation does not have to rely exclusively on expanding engineered infrastructure. Restoration of degraded ecosystems may support soil stability, water regulation and biodiversity. Vegetation can contribute to reducing erosion, while healthy soils influence water retention and agricultural productivity. In mountain regions, restoration measures may form part of broader efforts to manage slopes, catchments and agricultural landscapes.

Their effects depend on local ecological conditions and implementation. Restoration cannot be assumed to reverse every consequence of climate change. It may require substantial time, maintenance and cooperation between resource users. Some ecosystems cannot readily return to earlier conditions after severe or prolonged environmental change.

Nevertheless, restoration offers an approach that differs from treating the environment solely as a constraint to be overcome through engineering. It seeks to maintain or recover functions that support human livelihoods and other forms of life. For TEOS 2100, this is relevant to the possibility of preserving settlement viability. Communities may reduce environmental risks through combinations of ecosystem management, infrastructure and changes in economic activity.

These efforts may allow people to remain in places that would otherwise become more difficult to inhabit. They also illustrate why adaptation should not automatically be equated with relocation. The capacity to maintain functioning ecosystems is part of the broader capacity to sustain human settlement.

Planetary boundaries and political responsibility

The planetary boundaries framework describes environmental processes operating at a global scale. Political decisions, however, are made through institutions whose responsibilities are often national, regional or local. This creates a persistent governance problem.

An individual jurisdiction may benefit from an activity while some of its environmental consequences extend elsewhere. Greenhouse gas emissions contribute to global climate change regardless of where they originate. Land conversion may affect biodiversity and water cycles beyond the immediate development area. Material consumption in one region may depend on extraction and processing in another.

These relationships cannot be managed entirely through local decisions. They require cooperation across jurisdictions and economic systems. At the same time, global environmental objectives must be translated into actions affecting identifiable communities. Measures to reduce land conversion, resource use or emissions can influence employment, public services and access to land.

Their legitimacy depends partly on how these consequences are distributed and whether affected people can participate in decisions. The relationship between ecological limits and democratic governance is therefore central to a possible Post-Settlement Civilisation.

Environmental boundaries cannot determine political choices on their own. They provide information about risks and constraints. Institutions must decide how responsibilities are allocated, which activities are prioritised and how competing interests are addressed.

The question of equity

The environmental pressures associated with human activity are distributed unevenly. Countries and population groups differ in their historical contributions to greenhouse gas emissions, material consumption and land-use change. They also possess different capacities to adapt.

A household with sufficient income may relocate, improve housing or obtain alternative water supplies. Another household exposed to similar conditions may lack the resources to respond. The existence of planetary limits therefore does not establish that every person or community should bear identical restrictions.

Governance must consider differences in responsibility, vulnerability and capacity. This becomes relevant when populations move between regions. Receiving communities may face additional demands on resources while relocated households may have lost much of their economic security. Arrangements that disregard the circumstances of either group may produce conflict.

The scenarios developed in Chapter 6 illustrate alternative ways of addressing such tensions.

- *Fortress Earth* concentrates protection and access within selected territories.

- *Negotiated Mobility* relies on cooperation between states to organise movement and associated rights.
- *Networked Nomads* allows substantial economic connectivity while distributing protection unevenly.
- *Planetary Transition* explores more coordinated approaches to adaptation and resource allocation.

None eliminates ecological constraints. Their differences concern the institutions through which societies respond to those constraints.

Human expansion beyond Earth

The prospect of sustained human activity beyond Earth introduces a different meaning of expansion. Orbital facilities, lunar installations and possible future settlements on Mars would extend human activity into environments where natural conditions cannot support unprotected human life. Their operation would depend on technical systems providing air, water, temperature control and other essential functions.

These environments have their own physical and material constraints. Water and other resources would need to be transported, recovered or obtained from suitable local sources where technically feasible. Equipment would require maintenance and replacement. Energy systems would need to support life-support functions and other activities under demanding operating conditions.

At the same time, such facilities would remain connected to economic and industrial systems on Earth for the foreseeable future. Their development would require launch services, manufacturing, logistics and substantial investment. It would therefore be misleading to assume that human activity beyond Earth could relieve the ecological pressures affecting terrestrial populations within the period examined by TEOS 2100.

Space activities may produce scientific knowledge and technologies with terrestrial applications. However, the existence of such benefits does not establish that large-scale off-world settlement could replace climate adaptation or ecosystem protection. The environmental consequences of space infrastructure also require assessment.

Launch activities, industrial production and orbital operations have material and energy requirements. Human expansion beyond Earth cannot be treated as ecologically neutral merely because some activities occur outside the terrestrial surface.

Planetary limits and closed environments

The relationship between planetary boundaries and space habitation requires a distinction. Planetary boundaries describe processes regulating the stability and resilience of Earth's environmental systems. A lunar facility or orbital habitat would operate under different environmental conditions. Its immediate constraints would involve the performance of engineered systems and the availability of supplies.

It would therefore be incorrect to apply the planetary boundaries framework directly to an individual space habitat as though the same Earth-system processes operated within it. Nevertheless, both situations reveal the consequences of dependence on limited resources.

A space habitat may require carefully managed water recovery, air revitalisation and waste processing. Its inhabitants would need to monitor system performance and respond to interruptions.

On Earth, societies can draw on extensive ecological systems and global networks of production and exchange. Yet the planetary boundaries framework demonstrates that these wider systems also have limits. The comparison is therefore useful at the level of resource dependence, management and institutional responsibility.

It does not establish that Earth can be governed as a closed technical habitat. Earth's biosphere is vastly more complex than any engineered life-support system. Its ecological processes cannot be fully substituted by technologies designed for small, controlled environments.

The limits of the frontier idea

Human expansion has often been described through the language of frontiers. New territories appear as spaces for exploration, settlement and economic opportunity. Such narratives can obscure the societies and ecosystems already present in the areas concerned. On Earth, regions described as undeveloped may support longstanding forms of land use and cultural relationships. Treating them as available for expansion can reproduce conflicts over property, sovereignty and access to resources.

Beyond Earth, the legal and political circumstances differ. The 1967 Outer Space Treaty establishes that outer space, including the Moon and other celestial bodies, is not subject to national appropriation through claims of sovereignty. This does not resolve every question concerning resource utilisation, commercial activity or the governance of future installations.

It does, however, establish that extraterrestrial expansion cannot simply be understood as an extension of conventional territorial acquisition. For TEOS 2100, the broader relevance lies in the assumptions underlying expansion. Moving into a new environment does not remove the need to determine how resources are used, who may participate and which activities are permissible.

The availability of a new location does not automatically justify every form of development. These questions apply on Earth as well as beyond it, although their legal frameworks differ.

A different measure of progress

Human societies may continue developing new technologies, extending transport networks and increasing their ability to operate in unfamiliar environments. Such developments can create opportunities for research, economic activity and adaptation. However, geographical expansion is not itself a sufficient measure of civilisational progress.

A society can extend its reach while increasing inequality or degrading the ecological systems on which it depends. It can also improve living conditions through more effective use of existing resources, restoration of damaged environments and the development of institutions that manage competing interests.

For TEOS 2100, the ability to support human life under changing conditions is a more useful measure than the expansion of occupied territory. That ability includes maintaining viable settlements where possible, enabling relocation where necessary and managing resources without transferring unacceptable risks to other communities.

It also includes preserving opportunities for political participation and ensuring that individuals can challenge decisions affecting their lives. These requirements apply regardless of whether future societies become more geographically concentrated or more mobile.

Implications for TEOS 2100

The prospect of a Post-Settlement Civilisation does not eliminate the ecological foundations of human life. Movement may alter where people live and how they obtain essential resources. Technology may improve efficiency and allow some activities to operate under previously unsuitable conditions. Institutions may become more capable of coordinating livelihoods and public services across locations.

Yet all these developments remain dependent on material resources and functioning environmental systems. The scientific assessment of planetary boundaries indicates that many of the processes supporting Earth's stability are already under substantial pressure. This makes the governance of resource use central to any long-term discussion of settlement and mobility.

The possibility of developing new settlement areas cannot be separated from their ecological consequences. Nor can the prospect of human activities beyond Earth be treated as an alternative to addressing environmental pressures on this planet. For TEOS 2100, the relationship between human expansion and planetary boundaries is therefore one of continued responsibility.

The future may involve different distributions of population, new forms of infrastructure and a wider geographical reach for human activity. Whether these changes contribute to secure and viable societies will depend on how resources are used, how ecological systems are protected and how decisions are made. The capacity to inhabit new environments may extend humanity's possibilities. It does not diminish the responsibility to maintain the conditions for life in the environments people already occupy.

8.7 Space Settlement as Extreme Post-Settlement

Human life beyond Earth depends on conditions that cannot be taken for granted. A spacecraft, orbital station or lunar habitat must provide the air, water, temperature control and protection that terrestrial environments supply through a combination of natural systems and infrastructure. Its inhabitants cannot leave when essential services fail. Their safety depends on equipment, maintenance procedures and the capacity of people to respond to unexpected circumstances.

This creates a distinctive relationship between mobility and settlement.

Spacecraft travel across enormous distances, while orbital facilities continuously move relative to the Earth's surface. Yet people living inside them remain dependent on a highly

specific physical environment. They may experience geographical mobility on an extraordinary scale while having very limited freedom to change their immediate surroundings.

A future lunar or Martian settlement would be even more clearly tied to its location. Infrastructure, access to resources and the ability to maintain habitable conditions would determine whether people could remain there. Space habitation should therefore not be understood as the disappearance of settlement. It is a form of human habitation in which dependence on the place and its supporting systems becomes more visible and more difficult to escape.

For TEOS 2100, the significance of this relationship lies in the social and institutional questions it raises. How can essential services remain reliable when alternatives are limited? Who is responsible for maintaining shared infrastructure? How are resources allocated when failures can threaten the entire community? What rights should individuals possess when their lives depend on facilities operated by organisations located elsewhere?

These questions are already relevant to communities on Earth, although the environmental conditions and consequences of system failure differ substantially.

From exploration to sustained human presence

Human activities in space have historically been organised primarily around exploration, research and the operation of specialised technical systems. Crewed missions involve selected personnel working under established command structures. Their duration, objectives and operational responsibilities are defined before departure. The International Space Station has provided experience with long-duration human habitation in low Earth orbit. Its operations involve continuous international cooperation, the maintenance of complex technical systems and regular exchanges of crews and supplies.

However, a research station operated through agreements between space agencies is not equivalent to a permanent civilian settlement. Its inhabitants are selected for specific missions, and their activities are governed by professional and operational arrangements. A settlement involving people living beyond Earth for much longer periods would raise additional questions concerning employment, family life, education, healthcare and political participation.

Current developments provide reasons to examine these questions without assuming that such settlements will necessarily emerge. NASA's Artemis programme aims to return humans to the lunar surface and establish capabilities for sustained exploration and subsequent activities. Following changes to the programme announced in 2026, Artemis III is planned as a test mission in low Earth orbit in 2027. It is intended to demonstrate operations involving the Orion spacecraft and commercially developed lunar landing systems. NASA currently targets a crewed lunar landing through Artemis IV in 2028.[217]

[217] National Aeronautics and Space Administration (NASA) (2026). *NASA Shares Plans to Accelerate Artemis, Return to Moon*. 4 November 2026. https://www.nasa.gov/missions/artemis/nasa-shares-plans-to-accelerate-artemis-return-to-moon/

These plans represent a programme of exploration and infrastructure development, not an established permanent human settlement. Similarly, NASA is supporting the development of commercially operated space stations intended to provide research and other services in low Earth orbit after the International Space Station. In October 2026, NASA issued a request for proposals for commercial low Earth orbit destinations.[218]

These activities could broaden the range of organisations operating facilities used by humans in space. They do not establish when, or under what conditions, a self-sustaining orbital community might become feasible.

SpaceX has presented the establishment of a self-sustaining city on Mars as a long-term objective. Its published plans describe extensive requirements for cargo transport, infrastructure and local production. These remain ambitions whose feasibility depends on developments that have not yet been demonstrated at the necessary scale.[219]

For TEOS 2100, such initiatives provide contemporary examples of how human activities might extend beyond Earth. Their future outcomes remain uncertain.

Life support and technical dependence

The most immediate challenge of space habitation is maintaining conditions suitable for human life. In an orbital facility, the internal atmosphere must be controlled. Water needs to be supplied, recovered and treated. Temperature and humidity must remain within acceptable limits. Waste must be managed, and equipment must operate reliably over extended periods.

The International Space Station has provided a testing environment for technologies addressing these requirements. NASA reported that its Environmental Control and Life Support System demonstrated approximately 98 per cent water recovery in the United States segment of the station in 2023.[220]

This achievement illustrates the potential of resource recovery to reduce the need for resupply. It should not, however, be interpreted as proof of complete material self-sufficiency. Water recovery systems require power, maintenance and replacement components. Other consumables and materials must still be supplied or recovered through different processes.

A future habitat would depend on the performance of several interconnected systems. An interruption in electricity could affect air circulation, temperature regulation or water treatment. Equipment failures might require immediate repairs using tools and materials already available. The consequences of delay would depend on the function affected, the available reserves and the redundancy of the system.

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[218] NASA (2026). *NASA Seeks US Industry Plans for Commercial Space Stations*. 9 October 2026. https://www.nasa.gov/news-release/nasa-seeks-us-industry-plans-for-commercial-space-stations/
[219] SpaceX (2026). *Mars & Beyond: The Road to Making Humanity Multiplanetary*. Corporate programme description, accessed 8 November 2026. https://www.spacex.com/mars
[220] NASA (2023). *NASA's 2023 Space Station Achievements*. Section on water recovery and environmental control. https://www.nasa.gov/missions/station/iss-research/nasas-2023-space-station-achievements/

This makes reliability a central requirement. Critical functions may need backup equipment, independent monitoring and procedures for operating under degraded conditions. However, additional equipment increases mass, complexity and maintenance requirements. Engineering decisions must therefore balance reliability against the practical constraints of the mission or facility.

The comparison with terrestrial post-settlement technologies is useful at this level. Remote communities may also require decentralised water treatment, distributed energy and repair capacity. Yet they generally remain connected to the Earth's atmosphere, ecosystems and wider networks of supply.

A space habitat must create and maintain environmental conditions that are otherwise unavailable. The technical requirements are therefore substantially more demanding.

A settlement with limited alternatives

On Earth, the failure of essential infrastructure can produce severe consequences. A community may lose access to safe water, electricity or healthcare. However, some alternatives may remain available. People may obtain supplies from neighbouring regions, use temporary infrastructure or relocate. These options are not always accessible, particularly during widespread disasters or in isolated locations. Nevertheless, they form part of the broader possibilities available within the terrestrial environment.

Space habitation restricts these alternatives. A facility in low Earth orbit can maintain relatively frequent communication with Earth and may have possibilities for emergency return, depending on its vehicles and operational arrangements. A lunar facility would face different transport and logistical constraints. A crew travelling to Mars would experience much greater distance, communication delays and limited opportunities for immediate assistance. NASA identifies radiation, isolation, distance from Earth, altered gravity and hostile or closed environments among the major hazards of human spaceflight.[221]

These conditions affect both technical planning and the organisation of everyday life. Medical emergencies may require greater local capacity. Repair decisions may need to be made without immediate support from specialists on Earth. Conflicts between individuals can become more difficult when physical separation is impossible. The ability to leave an institution, workplace or community may be severely constrained by transport availability and the requirements of maintaining a safe environment.

For TEOS 2100, this raises a question extending beyond engineering. What does freedom of choice mean when people cannot readily leave the infrastructure on which their lives depend?

Work and the limits of operational authority

Current crewed space missions rely on defined responsibilities and established command arrangements. These are necessary for coordinating complex technical activities and responding to emergencies. A crew must be able to act quickly when equipment failure

[221] NASA, Human Research Program. *5 Hazards of Human Spaceflight*. https://www.nasa.gov/hrp/hazards/

threatens safety. Operational authority can therefore be extensive, and some decisions cannot be deferred to prolonged deliberation. Such arrangements are appropriate to particular mission conditions.

However, their application to hypothetical long-term civilian settlements would require further examination. A person employed to maintain equipment aboard a station may be subject to contractual obligations and operational rules. If that person lives in the facility for several years, the same rules may also influence housing, healthcare, communications and personal relationships.

Employment and residence could become closely connected. This may create dependencies resembling those examined in the Networked Nomads scenario. A worker who loses access to a digital employment platform may also lose access to services associated with that platform. In a privately operated space facility, the relationship could become more direct. If accommodation, transport and essential services are provided by the same organisation, changes in employment status may affect the person's ability to remain in a habitable environment.

The issue is not that commercial operation necessarily produces such outcomes. Rather, the concentration of responsibilities creates questions that require explicit legal and institutional arrangements. These could concern contractual protections, access to medical care, dispute resolution and responsibilities when employment ends.

The ability to terminate an employment relationship cannot be treated as equivalent to the practical ability to leave a remote habitat. Long-term habitation may therefore require a clearer separation between operational authority, employment decisions and the provision of essential services.

Political rights beyond Earth

Space law already establishes principles governing the activities of states and private organisations beyond Earth. The 1967 Outer Space Treaty provides the central international framework. Article II prohibits national appropriation of outer space, including the Moon and other celestial bodies, through claims of sovereignty, occupation or other means. Article VI establishes international responsibility for national space activities, including activities undertaken by non-governmental entities. Such activities require authorisation and continuing supervision by the appropriate state. Under Article VIII, the state of registry retains jurisdiction and control over a registered space object and its personnel while in outer space or on a celestial body.[222]

These provisions establish important relationships between space activities and terrestrial states. They do not amount to a complete constitutional framework for a future permanent settlement. A lunar facility may be operated by an organisation subject to one state's jurisdiction while accommodating people holding several nationalities. Its inhabitants may

[222] United Nations (1967). *Treaty on Principles Governing the Activities of States in the Exploration and Use of Outer Space, including the Moon and Other Celestial Bodies*, Articles II, VI and VIII. United Nations Treaty Series, Vol. 610, p. 205. https://legal.un.org/avl/ha/tos/tos.html

retain political rights in their countries of citizenship without possessing a comparable role in decisions governing the facility.

Operational decisions could be made by organisations located on Earth. This raises a problem already examined in Chapter 5.1. The people affected by decisions may not be identical to the population represented by the authority making them. For a temporary scientific mission, command structures and agreements between participating organisations may provide an appropriate framework. For a long-term settlement, questions about representation and political accountability could become more significant.

Residents might need procedures for influencing rules concerning daily life, access to services and the distribution of resources. The appropriate form of participation would depend on the legal status and organisation of the facility. It should not be assumed that a group of people living beyond Earth would automatically constitute a sovereign political community. Nor should the absence of territorial sovereignty be interpreted as the absence of political rights.

The challenge would be to maintain legitimate authority and meaningful participation within the applicable legal framework.

Existing experience with international jurisdiction

The International Space Station provides a concrete example of the coordination of jurisdiction between several states. Its legal framework is established through the 1998 Intergovernmental Agreement and associated arrangements. Under Article 5, participating states retain jurisdiction and control over the elements they register and over personnel who are their nationals, subject to the applicable agreements. Article 22 contains provisions concerning criminal jurisdiction and procedures for addressing certain situations involving the interests of more than one partner.[223]

These arrangements demonstrate that international cooperation in space does not require the creation of a new sovereign territory. Different jurisdictions can coexist within a shared technical facility. However, this framework was developed for a specific programme involving governmental partners and selected crews.

Its suitability for future commercial or permanent civilian facilities cannot be assumed without further consideration. A habitat accommodating residents over extended periods might encounter legal questions that are less prominent in current missions. These could include long-term employment rights, family relationships, access to education and the status of people who are no longer participating in an operational mission.

The division of responsibilities between the operator, the registering state and the states of nationality of individual residents would need to be clarified. The underlying challenge is

[223] Governments of Canada, Member States of the European Space Agency, Japan, the Russian Federation and the United States (1998). *Agreement concerning Cooperation on the Civil International Space Station*, Articles 5 and 22. https://www.esa.int/Science_Exploration/Human_and_Robotic_Exploration/International_Space_Station/International_Space_Station_legal_framework

familiar from terrestrial governance under extensive mobility. Legal authority, physical presence and political membership do not necessarily coincide.

Space habitation makes these relationships more visible because the physical environment itself depends on organised human activity.

Cooperation, competition and resource access

The development of lunar infrastructure may involve facilities operated by different countries and commercial organisations. These activities can create opportunities for scientific cooperation, shared services and the exchange of technical capabilities. They can also raise questions concerning access to locations and resources.

Certain sites may be attractive because of their physical characteristics, potential access to water-bearing materials or suitability for communications and energy infrastructure. The fact that a location is suitable for development does not establish that access can be allocated without conflict. Under the Outer Space Treaty, states cannot establish territorial sovereignty over the Moon.

However, questions concerning the utilisation of resources, the avoidance of harmful interference and the coordination of activities remain relevant. The Artemis Accords, initiated in 2020, provide a non-binding framework of principles intended to guide civil space exploration and use. They address matters including transparency, interoperability, emergency assistance, scientific information, resource utilisation and the avoidance of harmful interference. By 28 October 2026, the number of signatory states had reached 78.[224]

The accords do not create a general political authority governing all lunar activities. They represent an approach to cooperation among participating states. Future developments may require additional arrangements concerning access, operational responsibilities and dispute resolution.

The relevance to TEOS 2100 lies in the institutional management of resources shared across communities and jurisdictions. The conditions are different from those of a terrestrial river basin. Nevertheless, both situations require procedures for addressing activities whose consequences extend beyond a single operator or authority.

Scarcity and collective decisions

A space habitat must manage resources whose availability can be measured and constrained. Water, power, storage capacity and essential supplies have operational limits. Their allocation may need to change in response to system performance, mission requirements or unexpected events.

Technical models can provide information about consumption and available reserves. They cannot independently establish how competing human needs should be weighed. An emergency may require immediate restrictions to protect essential functions. Longer-term

[224] NASA (2026). *Artemis Accords: Principles for a Safe, Peaceful, and Prosperous Future in Space*. Status as of 28 October 2026. https://www.nasa.gov/artemis-accords/

decisions concerning living conditions, work schedules or access to facilities involve questions of fairness and responsibility.

A permanent community would need rules accepted as legitimate by the people subject to them. These rules might distinguish between emergency authority and ordinary decision-making. Operational leaders could retain the ability to act immediately when safety is threatened. Other decisions might require consultation, representation or independent review.

Such arrangements would need to be adapted to the size, composition and purpose of the community. The Water Assembly developed in Chapter 7 offers a terrestrial comparison. Its members must allocate limited water while considering established rights, changing conditions and the claims of newcomers.

The consequences of a disagreement over irrigation are not equivalent to a failure of life support in space. However, the political question has a common element. How should a community make legitimate decisions about resources on which its members depend? The answer cannot be supplied by monitoring equipment alone.

Care, health and social continuity

Long-term human habitation requires more than maintaining physical survival. People need opportunities for social relationships, personal development and access to appropriate healthcare. Current space missions already consider the effects of isolation and confinement on individual health and team performance. NASA identifies behavioural and psychological responses to prolonged isolation among the hazards requiring attention in mission planning.[225]

A permanent settlement would introduce additional questions. Residents might remain beyond the duration of an ordinary employment assignment. Families could potentially form, and individuals might require care unrelated to operational duties. Children and older adults would have different needs from those of a carefully selected professional crew. No existing experience of long-duration human spaceflight demonstrates that all these needs could be supported sustainably in an extraterrestrial settlement.

Medical care would also face constraints. Equipment, medicines and specialised personnel could be limited. Emergency evacuation might be difficult or impossible within a clinically appropriate period. Decisions about medical capacity and care responsibilities would therefore be central to settlement planning.

The experience of Nasrin in Chapter 7 provides another useful comparison. Her difficulty does not arise from insufficient technical knowledge. It arises because an employment system assumes mobility while failing to accommodate continuous responsibility for a dependent family member. A future space settlement could encounter related tensions between operational requirements and personal responsibilities.

[225] NASA, Human Research Program. *5 Hazards of Human Spaceflight*. https://www.nasa.gov/hrp/hazards/

The conditions would differ, but the need to recognise care as a component of social organisation would remain. A community cannot be considered viable over generations if its institutions address only the needs of people performing productive or technical functions.

Education and the development of community

The transition from a temporary research facility to a long-term settlement would change the role of education. Current crews receive extensive preparation for defined missions. Their training focuses on technical tasks, operational procedures, teamwork and emergency response. A community supporting residents over much longer periods would need broader educational arrangements.

Learning would involve professional development, cultural activities and the transmission of knowledge between generations. Where children were present, education would become part of everyday community life rather than an extension of mission training. The practical and ethical questions associated with children living beyond Earth remain substantial.

They concern health, development, access to appropriate care and the ability to make choices about residence. These issues cannot be resolved by assuming that education could simply be delivered through digital platforms. Educational institutions also provide social relationships and opportunities for participation. Their development would influence the character of a settlement.

This returns TEOS 2100 to the meaning of civilisational capability introduced in Chapter 8.2. A society becomes capable of maintaining life across locations when people can preserve access to learning, care and recognised rights as their circumstances change. The technological conditions of extraterrestrial habitation would be far more demanding. The institutional requirement for continuity would remain.

The freedom to remain and the freedom to leave

A central concern of TEOS 2100 is the ability of people to make meaningful decisions about where they live. That concern becomes more complex beyond Earth. A person living in a remote space facility may be able to communicate with family and institutions on Earth while lacking practical access to return transport. Their residence may depend on the continued operation of particular technical systems.

Leaving could require substantial preparation, available transportation and medical clearance. These constraints may be unavoidable under the physical conditions involved. However, they raise questions about how consent and personal autonomy should be understood. A person may voluntarily accept an assignment without being able to anticipate every future circumstance.

Health conditions may change. Family responsibilities may arise. Employment relationships may deteriorate. An arrangement that is acceptable at the beginning of a mission may become difficult to sustain over several years. Long-term habitation would therefore require clear procedures governing return, reassignment and the responsibilities of operators towards residents who cannot readily leave.

The freedom to remain also matters. A resident whose employment ends should not necessarily lose access to essential life-support services while arrangements for departure are unresolved. Such questions have no simple solution. They nevertheless demonstrate why the social organisation of space habitation cannot be considered separately from its technical infrastructure.

The distinction between a crew and a society

Current space missions involve groups organised around specific operational objectives. Their members are selected, trained and assigned responsibilities through established institutional procedures. A permanent settlement would be a different kind of human organisation.

Its inhabitants might hold different occupations and maintain personal relationships that extend beyond the mission. Their interests would not necessarily coincide with those of the operator or sponsoring institution. Disagreements could concern employment, access to services, use of shared resources or personal conduct.

The presence of such disagreements would not necessarily indicate failure. Conflict is a normal feature of human communities. The institutional question is whether disputes can be addressed without threatening essential functions or relying exclusively on operational command. A long-term settlement may therefore require distinctions between emergency management, ordinary administration and procedures for resolving disputes.

It might also need representative institutions whose authority is clearly defined. These possibilities remain speculative. Existing space law provides relevant foundations, but the constitutional and administrative arrangements of a hypothetical permanent extraterrestrial community cannot yet be established from current mission practice.

For TEOS 2100, the distinction is nevertheless important. A technically successful habitat is not automatically a functioning society. Its long-term viability would depend on institutions capable of supporting people whose lives extend beyond the performance of assigned tasks.

Space settlement and the Post-Settlement condition

The comparison between terrestrial mobility and space habitation requires care. People leaving environmentally exposed settlements on Earth generally seek access to places where human life can continue through existing ecological systems and infrastructure. People living beyond Earth would enter environments that cannot sustain unprotected human life.

The physical differences are fundamental. Space settlement is therefore not a direct extension of climate migration. Nor should terrestrial post-settlement societies be treated as an inevitable preliminary stage of human expansion beyond Earth. The connection is institutional. Both situations can separate individuals from the places in which their legal rights, economic relationships and political identities were established. Both may involve dependence on infrastructure managed by organisations outside the immediate community. Both raise questions about the allocation of resources, the continuity of essential services and the ability of residents to participate in decisions affecting their lives.

These similarities do not eliminate the differences in scale, risk and legal status. They provide an analytical basis for examining how human societies organise continuity under changing spatial conditions. The term *extreme post-settlement* is therefore useful only in a qualified sense.

Space habitation does not remove settlement. It creates highly dependent settlements in environments where the capacity to remain alive is sustained through technical systems. What becomes less securely connected to territory is the organisation of rights, authority and social relationships. A resident may inhabit a specific facility while depending on institutions, economic systems and political communities located far beyond it.

Implications for TEOS 2100

Human activities beyond Earth provide a longer-term perspective on the relationship between settlement, mobility and institutional capacity. They demonstrate how technical systems can create habitable environments under conditions that would otherwise prevent human life. They also show why engineering alone cannot answer every question associated with sustained habitation.

Current programmes offer valuable experience but do not establish the feasibility of independent, permanent space settlements. The development of such communities would require further advances in life support, health protection, transport and resource management. It would also require legal and institutional arrangements capable of addressing the rights and responsibilities of their inhabitants.

These arrangements cannot be derived directly from existing models of territorial government or from the command structures used for temporary missions. They would need to reflect the physical dependence of residents while preserving accountability and meaningful opportunities for participation. For TEOS 2100, the immediate relevance remains on Earth. The challenges facing communities in the Hindu Kush Himalaya are not equivalent to those of a lunar or Martian settlement.

However, the examination of future space habitation reveals a broader question already present throughout this report. How can human societies maintain secure lives, recognised rights and legitimate institutions when people depend on systems extending far beyond the places they physically occupy?

Space habitation places that question in an environment where the consequences of institutional and technical failure may be immediate. It does not provide an escape from the social responsibilities examined in TEOS 2100. It offers a more demanding setting in which their importance can be considered.

8.8 The Spacefaring Civilisation Pathway

Humanity's ability to travel beyond Earth has developed through scientific research, industrial investment and technological advances extending over several generations. Spacecraft, orbital infrastructure and robotic exploration have expanded the environments in which human activities can take place. These achievements demonstrate substantial

technical capabilities. They do not, however, establish that humanity has developed the institutions required for permanent and socially viable habitation beyond Earth.

The distinction matters for the long-term perspective of TEOS 2100. A spacecraft can transport people into orbit without resolving how a community might organise political participation over several generations. A lunar habitat may maintain breathable air and recover water while remaining dependent on external organisations for financing, supplies and operational decisions. The capacity to reach a location is therefore different from the capacity to sustain a society there.

This distinction also applies to changing settlement conditions on Earth. People may move away from environmental hazards without gaining secure access to livelihoods or public services elsewhere. Governments may establish relocation programmes while leaving questions of political membership and financial responsibility unresolved. The development of mobility and the development of institutions capable of supporting mobile lives do not necessarily occur at the same pace.

The original TEOS 2100 framework identified four stages connecting crisis-driven movement to the longer-term possibility of a spacefaring civilisation. These stages remain useful, provided they are understood as related dimensions of development rather than an inevitable historical sequence. They describe different capabilities that societies may develop, neglect or combine in response to changing circumstances.

Crisis mobility: responding to immediate pressures

Crisis mobility occurs when movement becomes a response to conditions that people can no longer manage within their existing living arrangements. Environmental hazards, economic disruption, conflict or the breakdown of public services may contribute to such circumstances. Movement may happen suddenly, as in the aftermath of a destructive flood, or develop gradually as households lose the resources required to remain.

The distinction between these processes is relevant to public planning. Sudden displacement may require evacuation and emergency accommodation. Gradual deterioration may allow more time for adaptation or relocation, although the availability of time does not guarantee that affected households possess meaningful alternatives. Institutions frequently respond to these situations through arrangements developed for emergencies.

Temporary shelter, humanitarian assistance and administrative measures can protect people during immediate crises. However, these responses may be inadequate when displacement becomes prolonged. Housing, employment, education and healthcare require continuity beyond the initial emergency. Crisis mobility reveals the dependence of human lives on institutions that are often organised around stable residence.

A family may be physically safe after relocation but remain unable to obtain recognised employment or secure accommodation. Children may resume education only after substantial delays. Individuals may lose access to medical treatment or administrative documents. Such difficulties do not arise from movement alone. They emerge when institutions cannot maintain essential relationships and services as people's locations change.

For TEOS 2100, crisis mobility represents a condition in which environmental and social pressures expose existing institutional weaknesses. It is not necessarily the first stage of a wider civilisational transformation. Many societies experience crisis-related movement without subsequently developing comprehensive systems for supporting mobile populations.

The transition to more reliable arrangements depends on political decisions and institutional investment.

Designed mobility: preparing viable alternatives

Designed mobility refers to the deliberate preparation of conditions under which people can move without repeatedly losing access to the foundations of everyday life. Chapter 8.3 examined the distinction between such preparation and the forced management of population movement. The purpose of designed mobility is not to direct people towards predetermined destinations.

It is to create viable alternatives where relocation becomes necessary or desirable. This may involve the coordination of housing, transport, employment, education and healthcare across jurisdictions. It may also require agreements recognising professional qualifications, maintaining social protection and clarifying responsibilities for public services.

The relevant infrastructure includes physical facilities and administrative systems. Receiving municipalities need sufficient capacity to accommodate population changes. Origin regions may retain responsibilities concerning property, legal records and social benefits. Where movement crosses national borders, states must negotiate the conditions under which people can enter, remain and participate in economic life.

Designed mobility also requires procedures for involving affected populations in decisions. Relocation cannot be considered adequately planned if the people concerned lack meaningful opportunities to assess alternatives or challenge arrangements affecting their future. This dimension of development may be relevant even where large-scale environmental displacement does not occur.

Countries already coordinate various forms of international employment, education and social protection. The expansion and adaptation of such arrangements could strengthen institutional capacity to respond to environmental mobility.

However, designed mobility remains vulnerable to unequal access. People with recognised employment, financial reserves and secure legal status may benefit more readily than those dependent on informal work or facing substantial care responsibilities. An institutionally developed mobility system must therefore be evaluated according to whom it serves. Its effectiveness cannot be established solely by the efficiency of transport or administrative processing.

Post-Settlement Civilisation: maintaining society across places

The concept of a Post-Settlement Civilisation describes a broader possibility. It concerns societies in which access to rights, livelihoods and essential services no longer depends as heavily on permanent residence in one location. This does not require the disappearance of

established settlements. Cities, villages and rural communities may continue providing the physical foundations of everyday life.

What changes is the ability of people and institutions to maintain continuity across them. A person could work in several regions while retaining recognised qualifications and social entitlements. A family might maintain relationships and responsibilities in more than one country. Public institutions could coordinate services for people whose lives do not fit neatly within a single administrative district. Political participation would also need to accommodate changing relationships between citizenship, residence and affectedness.

These developments would not necessarily create a uniform model of society. Some populations might remain closely connected to particular places. Others could adopt seasonal or repeated movement as part of their livelihoods. Still others might relocate permanently while maintaining social and cultural relationships with places of origin.

The relevant capability is the ability to support these different arrangements. This requires institutions that remain accountable as responsibilities extend across jurisdictions. It also requires careful management of shared resources. Mobility may alter where demand for water, energy and housing arises. It cannot eliminate the physical limits within which that demand must be met.

A Post-Settlement Civilisation would therefore need to combine institutional flexibility with ecological responsibility. Its development cannot be inferred simply from the growth of international migration or digital economic activity. Such developments may expand movement while leaving individuals exposed to new dependencies.

The four scenarios in Chapter 6 illustrate this distinction.

- *Negotiated Mobility* and *Networked Nomads* both involve substantial movement, but they differ in the institutions responsible for protecting rights.
- *Planetary Transition* emphasises coordinated adaptation and the management of shared resources.
- *Fortress Earth* demonstrates that societies may instead respond through exclusion and territorial restriction.

None of these outcomes is predetermined. The concept of a Post-Settlement Civilisation provides a framework for examining how the relationship between people and territory could change, rather than a prediction that one particular form of social organisation will emerge.

Spacefaring Civilisation: extending human activity beyond Earth

Human activity beyond Earth is already a reality. Orbital stations, robotic spacecraft and scientific missions have established forms of technological and institutional cooperation extending beyond the planet's surface. Current plans for lunar exploration and commercial orbital infrastructure could broaden these activities. Longer-term ambitions concerning Mars introduce the possibility of human habitation at much greater distances.

However, a civilisation conducting space missions is not necessarily a civilisation capable of sustaining permanent societies beyond Earth. The distinction concerns the continuity and organisation of human life. Temporary missions operate within defined objectives and

institutional arrangements. Their participants can be selected and trained for specific tasks. Long-term habitation would require a wider range of social functions.

People would need access to healthcare, education and appropriate living conditions over extended periods. Employment and operational responsibilities would have to coexist with personal relationships and individual rights. Institutions would need procedures for resolving disagreements without undermining the safety of the habitat. Political authority would also require a clear legal basis.

Existing international space law establishes principles governing state responsibility, jurisdiction and the use of outer space. It does not provide a complete framework for the internal political organisation of hypothetical permanent extraterrestrial settlements. Chapter 8.7 examined these questions in relation to current programmes and legal arrangements.

For TEOS 2100, their significance lies in revealing that technical capability and institutional development are separate requirements. A future spacefaring civilisation might possess advanced transport systems while remaining dependent on political structures developed for temporary missions. Alternatively, institutions could evolve to address the needs of people living beyond Earth for much longer periods.

Neither outcome can be established in advance. The future organisation of such communities would depend on the purposes of space activities, their economic foundations, the technologies available and the decisions of participating governments and organisations.

Four capabilities, not four inevitable stages

The four developmental areas can be considered through the different problems they address.

- Crisis mobility concerns the ability to protect people when established living conditions are disrupted.
- Designed mobility concerns the capacity to prepare alternatives and maintain essential services as people move.
- Post-Settlement Civilisation concerns the broader organisation of rights and responsibilities across changing relationships between people and places.
- Spacefaring Civilisation concerns the ability to sustain human activity and, potentially, communities in environments beyond Earth.

The relationship between them is neither automatic nor strictly sequential. Space activities can develop while terrestrial institutions remain poorly equipped to support displaced populations. A country may establish reliable systems of international mobility without pursuing extensive space exploration. A future lunar facility could develop sophisticated life-support technologies while offering limited opportunities for political participation.

Conversely, institutional innovations developed for mobile populations on Earth might provide useful experience for the governance of remote facilities. These possibilities demonstrate why the proposed pathway should not be interpreted as a forecast. It is a framework for comparing capabilities and identifying areas in which technological progress may exceed institutional development.

The central issue is whether societies can maintain continuity and accountability as their activities extend across increasingly varied environments.

The relationship between technology and social capacity

Human spaceflight requires advanced engineering. Launch systems must operate reliably. Habitats must maintain suitable environmental conditions. Communication and navigation systems must support activities across considerable distances. These technical requirements are substantial and cannot be replaced by institutional arrangements.

However, their successful development does not establish how the people using them should live together. A community may possess efficient water-recovery equipment while disagreeing over access to its output. An organisation may maintain reliable communications with Earth without providing residents with meaningful influence over decisions made by its management. A settlement may have extensive repair capabilities while relying on employment arrangements that give individuals little security.

These examples concern different kinds of problems. Technical systems can be assessed through performance, reliability and safety. Political and social institutions require consideration of legitimacy, rights and responsibilities. Their effectiveness depends partly on whether people can participate in decisions and obtain remedies when rules are applied unfairly.

Both dimensions would be necessary for sustained habitation beyond Earth. The development of one cannot be treated as evidence that the other will follow. This is also relevant to technological adaptation on Earth.

Digital records, automated logistics and decentralised resource systems may support mobility. Their social consequences depend on the institutions through which access is organised. A technologically advanced mobile society can remain unequal or politically restrictive. The same possibility would exist beyond Earth.

What terrestrial adaptation can contribute

TEOS 2100 does not suggest that climate-related mobility provides direct preparation for space settlement. The physical conditions are too different for such a conclusion. Nevertheless, terrestrial adaptation may generate institutional experience relevant to the organisation of human life across multiple locations.

Cross-border social protection arrangements can demonstrate how rights remain recognised when people move between jurisdictions. Regional water institutions can provide experience in managing resources whose availability affects several communities. Local participation procedures can help identify ways of involving people who are affected by decisions but do not possess established membership rights. These experiences may offer lessons for future organisations operating remote or technically dependent facilities.

Their relevance would need to be assessed in context. A procedure effective for managing irrigation water does not automatically provide a suitable model for allocating life-support resources aboard a spacecraft. Similarly, the political arrangements of a municipality cannot simply be transferred to an orbital habitat.

The underlying questions may be related while the appropriate solutions differ. The value of comparison lies in identifying institutional problems that might otherwise remain obscured by technological discussions. These include the allocation of authority, continuity of rights and responsibilities for maintaining essential services.

What space activities can contribute to Earth

The relationship between terrestrial adaptation and space activity need not operate in one direction. Research conducted for space missions can generate knowledge relevant to resource efficiency, environmental monitoring and the operation of systems in isolated environments.

Water recovery, remote medical support, autonomous maintenance and controlled-environment technologies are examples of areas in which technological approaches may have applications beyond their original purpose.

However, such transfer is not automatic. Technologies developed for space can involve high costs, specialised materials and operating requirements that make them unsuitable for many terrestrial settings. Their performance must be assessed according to the conditions in which they would be used. For example, a water-treatment process developed for a space station may demonstrate valuable engineering principles without providing an economical solution for a rural community.

The same applies to controlled-environment agriculture and autonomous logistics. Research can expand technical possibilities, but implementation depends on local resources, infrastructure and institutional capacity. TEOS 2100 therefore does not treat space exploration as a substitute for terrestrial development. It recognises that selected knowledge and technologies may contribute to solving problems on Earth, provided their relevance and feasibility are established.

The question of social learning

The possibility of a spacefaring civilisation raises a broader question about how societies develop the capacity to operate in unfamiliar environments. Technological knowledge can be accumulated through research, experimentation and practical experience. Social and institutional arrangements also evolve through experience, although their development is less predictable.

Institutions respond to conflict, changing expectations and new forms of cooperation. Legal systems adapt to circumstances that earlier rules did not anticipate. Communities revise their practices when established arrangements no longer serve their needs. These processes do not necessarily produce improvement.

Institutions may become more inclusive, but they may also reinforce exclusion or concentrate authority. The development of social capacity therefore requires political choices. The experience of mobility on Earth may contribute to this process by exposing gaps between existing institutions and the lives of the people they govern.

Individuals who maintain livelihoods across several countries may reveal weaknesses in social protection arrangements. Communities sharing limited resources may develop

procedures for negotiating competing claims. Residents whose citizenship and place of residence differ may raise questions about democratic representation.

These problems are relevant regardless of whether extensive settlement beyond Earth ever becomes possible. They concern the ability of human societies to organise cooperation under changing conditions.

A pathway without a predetermined destination

The idea of moving from nomadic societies towards the stars can be understood as a way of examining the expanding spatial reach of human activity. It should not be interpreted as a historical necessity.

The development of a Post-Settlement Civilisation would not require a transition to space habitation. Nor would the establishment of permanent facilities beyond Earth demonstrate that humanity had resolved the ecological and institutional problems affecting terrestrial societies.

Several futures remain possible. Space activity may continue to focus primarily on research, infrastructure and limited professional habitation. More extensive facilities might emerge without becoming politically or economically independent communities. Some forms of long-duration habitation may remain technically or financially impractical.

The same uncertainty applies to the future organisation of mobility on Earth. Environmental change will influence settlement conditions, but political and social responses will shape how people adapt. TEOS 2100 therefore treats the proposed pathway as an analytical connection between different forms of human capability.

Crisis mobility reveals the consequences of institutional disruption. Designed mobility examines how those consequences might be reduced. Post-Settlement Civilisation explores broader forms of social continuity across locations. Spacefaring Civilisation raises the question of how human life could be sustained and governed in environments where dependence on infrastructure becomes more extensive.

These developments may interact, but none is guaranteed to produce the next.

Implications for TEOS 2100

The long-term significance of human mobility lies in the relationship between movement and the institutions that support everyday life. Physical access to a new location does not automatically provide security. People require livelihoods, recognised rights, public services and opportunities to participate in the decisions affecting them. These requirements apply to movement within countries, across national borders and, under different conditions, to the prospect of sustained habitation beyond Earth.

The technological challenges vary considerably. The social questions remain connected through the need to organise responsibility across distance and changing environments. For TEOS 2100, the possible pathway from nomadic societies towards a spacefaring civilisation is therefore neither a prediction nor an argument for human expansion.

It is a perspective from which to examine the development of civilisational capabilities. The ability to maintain human life across multiple locations may become increasingly relevant during the twenty-first century. Its value will depend on whether institutions can support people who move, protect those who remain and manage shared resources within ecological limits.

Whatever humanity's future activities beyond Earth may become, these responsibilities will continue to shape the viability of human societies on this planet.

8.9 Risks of the Wrong Transition

The future of human settlement will depend on decisions made under conditions of environmental, economic and political uncertainty. As some regions become more difficult to inhabit, societies may invest in adaptation, develop agreements for relocation or introduce technologies that allow people to maintain livelihoods across several locations. These developments could expand the range of choices available to individuals and communities. They could also reinforce existing inequalities or create new forms of dependence.

Mobility does not automatically provide freedom. A person may be permitted to move while having little control over their destination, employment or access to essential services. A community may benefit from new infrastructure while losing influence over the resources on which its livelihood depends. Similarly, technological advances can improve the efficiency of public administration while increasing the capacity of governments or private organisations to monitor and regulate individual behaviour.

For TEOS 2100, the risks associated with a transition towards more mobile forms of society must therefore be examined alongside its potential benefits. The four scenarios developed in Chapter 6 provide different examples of how these risks might emerge. Fortress Earth explores the consequences of restricting access to protected territories. Negotiated Mobility demonstrates how formal agreements can expand movement while leaving difficult questions of implementation unresolved. Networked Nomads examines dependence on private economic systems, while Planetary Transition considers the challenges of coordinating adaptation and shared resource management.

These futures are not categories of success and failure. Each involves institutional choices that could improve or undermine the conditions under which people live. Seven risks are relevant across these possible developments.

Militarised mobility

Environmental pressures may influence national security policies, particularly where population movements interact with existing political tensions. Governments have legitimate responsibilities to maintain public order, protect their populations and manage national borders.

However, measures adopted for these purposes can also restrict the rights of people seeking safety or access to viable livelihoods. A security-oriented approach may treat mobile populations primarily as potential threats rather than individuals possessing legal rights and legitimate needs. Movement corridors could become subject to extensive surveillance and

restrictions. Temporary accommodation might develop into prolonged confinement where people lack opportunities to establish independent lives. Border enforcement could receive priority over access to healthcare, education and legal assistance.

Such developments would not necessarily prevent migration. They could instead change the conditions under which it occurs, increasing dependence on informal routes and exposing people to greater risks. The Fortress Earth scenario illustrates one possible outcome. Protected settlements retain access to infrastructure and resources while entry is restricted through administrative and physical controls.

These restrictions may be justified as necessary to maintain environmental security and public services. Yet the resulting arrangements raise questions about who receives protection and who remains excluded. A society could become technically capable of maintaining secure living conditions for selected populations while offering few viable alternatives to those outside its protected areas.

For TEOS 2100, the central concern is the possibility that environmental adaptation becomes increasingly associated with territorial exclusion. Security measures may be necessary under particular circumstances. Their legitimacy depends on lawful authority, proportionality and the protection of individual rights. Mobility policies that rely predominantly on coercion risk transforming environmental insecurity into prolonged political and social marginalisation.

Unequal access to mobility

The ability to relocate depends partly on economic and social resources. People with sufficient income may obtain alternative housing, finance transport and maintain livelihoods during transitions between locations. They may also possess professional qualifications recognised in several jurisdictions or access to employment that does not require permanent residence. Other households may lack these advantages.

The costs of moving can include transport, accommodation, administrative fees and periods without income. People may also lose access to land, employment networks and social support when they leave established communities. Where relocation requires substantial private expenditure, mobility may become increasingly divided according to household resources. Wealthier populations could obtain access to safer settlements and more reliable infrastructure, while poorer households remain in exposed locations or move under insecure conditions.

This inequality may also influence the ability to remain. Households with sufficient resources may invest in water storage, protective infrastructure or alternative energy systems. Others may be unable to maintain viable living conditions despite wishing to stay. The resulting difference is not simply between mobile and settled populations. It is between people who possess meaningful choices and those whose decisions are constrained by circumstances beyond their control.

The Networked Nomads scenario illustrates another dimension of this problem. Individuals with recognised skills and reliable digital access may obtain employment through international networks. Those lacking qualifications, connectivity or the resources required to

accept assignments may remain excluded. The existence of flexible employment opportunities does not guarantee equal access to them.

For TEOS 2100, mobility should therefore be assessed according to its distribution. A system that enables extensive movement among economically secure populations while leaving others without protection would not resolve the inequalities associated with environmental change. It could reproduce them across a wider geographical area.

Conflict over shared resources

Changes in settlement patterns may alter demand for water, land, energy and public services. Receiving communities may need additional infrastructure to accommodate new residents. Agricultural regions may experience competition over irrigation, while urban areas face pressure on housing and transport.

These circumstances do not necessarily lead to conflict. Their consequences depend on resource availability, institutional capacity and the ways competing interests are addressed. However, disagreements may become more difficult where environmental pressures reduce the resources available for allocation. Established residents may believe that newcomers are receiving access to services or land to which they have contributed over many years. Newcomers may consider themselves excluded from opportunities despite working and participating in the local economy.

Public authorities may struggle to reconcile these claims when available resources are insufficient. The Planetary Transition scenario demonstrates that coordinated adaptation does not eliminate such tensions. Rahmat and Daniyal confront the need to reduce water consumption within an established agricultural community. Haroon, a newcomer who has contributed to maintaining the irrigation system, seeks access to land and water but lacks recognised membership.

Their disagreement concerns both resource availability and the rules governing participation.

The Water Assembly provides a procedure through which these interests can be considered. It does not guarantee that every participant will be satisfied. For TEOS 2100, this distinction is important.

Collective resource management can support cooperation, but its effectiveness depends on whether institutions remain capable of addressing changing needs and membership. Rules based exclusively on established rights may become difficult to sustain as populations change. Conversely, arrangements that disregard existing responsibilities and ecological limits may undermine cooperation among established users.

Resource governance must therefore balance continuity with the legitimate claims of new participants. Where such mechanisms are absent or ineffective, competition may deepen social divisions and increase the risk of conflict.

Digital control and administrative exclusion

Digital technologies can support people whose lives extend across several locations. Electronic records may improve access to education, healthcare and employment. Digital

identity systems can facilitate the recognition of qualifications and legal status. Data exchange may also help public authorities coordinate services and respond to changes in population demand.

However, the same systems can expand the ability of organisations to monitor movement and restrict access. A digital identity may become a condition for receiving essential services. Employment platforms can determine eligibility through automated assessments. Administrative systems may use data concerning residence or employment to classify individuals without adequately reflecting their circumstances.

Where several systems are connected, a decision made by one organisation may influence access to services elsewhere. An incorrect record or administrative classification could therefore have consequences extending beyond a single institution. The ability to correct information and challenge decisions becomes essential.

Digital systems also create risks concerning privacy and surveillance. Records of movement, employment and service use can reveal detailed information about individuals and their relationships. Their collection may be justified for particular administrative purposes, but extensive or poorly controlled data sharing can make people vulnerable to monitoring beyond what is necessary to provide services.

For mobile populations, these risks are significant because digital records may become the principal means through which institutions recognise their identities and rights. A person who cannot access or correct such records may experience exclusion despite possessing valid legal entitlements.

The alternative is not necessarily to reject digital systems. It is to establish appropriate limits on data collection, ensure accountability and maintain accessible procedures for review. People should also retain practical ways of obtaining essential services when digital systems are unavailable.

For TEOS 2100, the expansion of digital governance must therefore be accompanied by protections against administrative exclusion and disproportionate surveillance. Otherwise, physical mobility could coexist with forms of control that are less visible than conventional territorial restrictions.

Corporate dependency

Private organisations already provide services that are essential to modern economic life. They operate communication networks, transport systems, financial platforms and infrastructure. Their involvement can support innovation and expand access to services. However, dependence on private providers may create difficulties where alternatives are limited or where essential functions are controlled through a small number of organisations.

In a highly mobile society, private platforms could coordinate employment, accommodation, transport and access to financial services across several jurisdictions. Such arrangements might reduce administrative barriers and improve economic flexibility. They could also concentrate influence over individuals' lives. A worker who depends on one platform for employment may have limited ability to negotiate conditions or challenge suspension.

If accommodation and other services are linked to that employment, the consequences of losing access may extend beyond income. The experiences of Amara and Nasrin in Chapter 7 illustrate different forms of this dependence. Amara's technical contribution becomes subject to the rules of a commercial network, while Nasrin's ability to work is constrained by an employment system that does not adequately accommodate care responsibilities.

Neither situation can be understood solely as a question of technological efficiency. They concern the allocation of authority and responsibility. Commercial providers may operate according to contractual arrangements that do not offer individuals the same mechanisms of accountability as public institutions. This distinction becomes relevant when private systems perform functions on which people depend for essential services.

For TEOS 2100, the risk is that mobility becomes organised through commercial relationships without corresponding protection of public interests. Appropriate regulation, access to remedies and clarity about institutional responsibilities are therefore important. Private organisations may remain valuable participants in mobile societies. However, their role should not remove the ability of individuals to exercise recognised rights or obtain essential services through accountable arrangements.

Cultural fragmentation and the loss of belonging

Movement can affect relationships that have developed over generations. People may leave places associated with family history, cultural practices and established forms of community life. Languages and traditions may be maintained across distance, but the circumstances under which they are practised can change. Relocation may separate households or alter relationships between generations. Receiving communities may also experience substantial social change.

New languages, occupations and cultural practices may become part of everyday life, while established residents reconsider how their community defines membership. These developments can support exchange and create new relationships. They can also generate uncertainty and disagreement. Cultural fragmentation becomes a risk where institutions fail to provide opportunities for meaningful interaction and participation.

Mobile populations may remain connected primarily through networks associated with their places of origin. Established communities may develop procedures that limit newcomers' access to local institutions. Social relationships can become divided even when people share the same physical environment.

For TEOS 2100, the issue is not whether cultural differences should disappear. Cultural diversity can remain an important part of individual and collective identity. The problem arises when differences become associated with unequal access to rights, resources or political participation.

The Human Stories demonstrate several dimensions of belonging. Asha maintains connections to her former home while developing a life elsewhere. Farid must consider the interests of arriving households and established residents. Haroon contributes to a community without immediately acquiring recognised membership.

Their experiences show that belonging cannot always be reduced to birthplace, citizenship or residence. It develops through relationships, participation and shared responsibility. However, these relationships cannot be established solely through administrative decisions. They require time, opportunities for interaction and institutions capable of accommodating people with different histories and expectations.

A mobile society may support strong social connections across distances. It may also create divisions if participation becomes dependent on economic resources or established membership. For TEOS 2100, cultural continuity and social inclusion are therefore relevant to the viability of future settlement arrangements.

Expansion beyond Earth without adequate rights and responsibilities

Human activities beyond Earth could introduce new forms of economic and institutional organisation. Commercial orbital facilities, lunar infrastructure and possible future settlements on other celestial bodies would depend on substantial investment, technical expertise and international legal arrangements. Their development might involve governments, private organisations and partnerships between several institutions.

Such activities could generate scientific knowledge and technological advances. However, they could also reproduce inequalities and governance problems already present on Earth. Access to space infrastructure may remain concentrated among organisations with substantial financial and technological resources.

The operation of facilities could depend on contractual arrangements granting private providers extensive control over employment and essential services. Residents might possess limited influence over decisions affecting their living conditions. These risks would become more significant if facilities developed from temporary operational environments into places where people reside for extended periods.

The distinction between a professional crew and a civilian community would require careful consideration. An organisation responsible for life-support infrastructure must be able to maintain operational safety. Yet technical responsibility does not automatically establish legitimate authority over every aspect of residents' lives. Questions concerning personal rights, employment, healthcare and political participation would need to be addressed within applicable legal frameworks.

Resource utilisation presents further questions. Activities on the Moon or other celestial bodies may involve competition over suitable locations, infrastructure and resources. Existing space law establishes principles governing state responsibility and the non-appropriation of outer space. It does not resolve every question concerning the governance of hypothetical permanent settlements.

For TEOS 2100, the relevant risk is that technological capabilities develop more rapidly than institutions capable of ensuring accountability and protecting the interests of affected people. Human expansion beyond Earth would not automatically produce a more equitable society. The social and political consequences would depend on the arrangements through which activities are authorised, financed and governed.

Risks that reinforce one another

The seven risks considered above are not independent. Territorial restrictions may increase economic inequality by limiting access to secure locations. Unequal mobility can place greater pressure on communities already facing resource shortages. Competition over resources may encourage the adoption of restrictive security measures. Digital systems may facilitate the enforcement of those restrictions or determine eligibility for services. Private networks may expand opportunities while concentrating control over employment and infrastructure. Cultural divisions can deepen when people perceive that access to resources and political influence is distributed unfairly.

These relationships may create reinforcing patterns. A community receiving new residents without sufficient investment may experience pressure on housing and public services. If established residents and newcomers lack effective opportunities to participate in decisions, disagreements may become more difficult to resolve. Authorities may respond through administrative restrictions or increased monitoring.

Such measures could further reduce trust and encourage separation between groups. The resulting conflict would not have been caused by mobility alone. It would reflect the interaction between resource availability, institutional capacity and political decisions. For TEOS 2100, this demonstrates why individual policy measures cannot be assessed independently of the wider systems in which they operate.

A technically efficient arrangement may create social costs if it weakens accountability. A programme that facilitates relocation may increase insecurity if receiving communities lack the resources needed to provide services. A resource-management institution may protect established users while excluding people whose lives increasingly depend on its decisions. The effectiveness of adaptation depends on recognising these relationships.

Recognising harmful developments before they become entrenched

Long-term foresight cannot establish which risks will occur. It can, however, identify institutional conditions that may increase vulnerability. These include unclear responsibilities, unequal access to essential services, limited opportunities for political participation and dependence on systems that individuals cannot challenge.

Such conditions can be examined before environmental pressures become more severe. Governments and public institutions may assess whether relocation programmes provide viable alternatives. Municipalities can evaluate whether planned infrastructure is sufficient for expected population changes. Regional organisations can examine whether agreements provide continuity of legal status and public services.

The operators of digital systems can be required to explain decisions and establish accessible procedures for review. Communities managing shared resources can reconsider membership rules when population patterns change. These measures do not eliminate conflict or guarantee successful adaptation. They may, however, reduce the likelihood that temporary arrangements develop into persistent forms of exclusion.

The distinction between anticipation and prediction remains important. TEOS 2100 does not assume that all the risks identified here will increase simultaneously or affect every region in

the same way. Their significance will depend on future environmental conditions, economic developments and political choices. The purpose of examining them is to make possible consequences visible while institutions still possess opportunities to respond.

The quality of the transition

The prospect of a Post-Settlement Civilisation is not inherently positive or negative. It describes possible changes in the relationship between human societies and the places they inhabit. Those changes may provide greater flexibility in the organisation of livelihoods and public services. They may also expose people to new forms of dependence.

The direction of development will be influenced by how institutions allocate responsibilities, protect rights and respond to competing claims. A society may become capable of supporting extensive movement while restricting political participation. It may maintain reliable infrastructure while excluding people who cannot afford access. It may establish sophisticated environmental monitoring systems without providing mechanisms for affected communities to influence decisions.

These outcomes would demonstrate technological or administrative capacity without necessarily establishing social viability. For TEOS 2100, the quality of a transition must therefore be evaluated through the conditions experienced by people. Can they maintain access to essential services? Do they possess realistic options concerning movement and residence? Can they obtain protection when employment or administrative arrangements fail? Are they able to participate in decisions affecting their lives?

The answers cannot be derived from settlement patterns or mobility rates alone. They require examination of institutions and the relationships between the people they govern.

Implications for TEOS 2100

The risks of a poorly governed transition arise from the possibility that societies respond to changing environmental conditions without addressing the institutional consequences. Mobility may expand while rights remain tied to fixed residence. Technologies may connect people across borders while concentrating authority within private organisations.

Resource-management systems may become more efficient while excluding populations without recognised membership. New settlements may provide physical security while weakening the relationships through which people experience belonging. These developments are possible within different political and economic futures.

They are not unavoidable consequences of environmental change. For TEOS 2100, the central concern is whether societies develop the capacity to maintain security, accountability and participation as their relationships with territory change. The ability to relocate, operate infrastructure across regions or sustain human life in remote environments cannot be regarded as sufficient evidence of successful adaptation.

The rights and opportunities available to the people affected are equally relevant. A future characterised by greater mobility may provide new forms of freedom. Whether those opportunities become widely accessible will depend on political choices concerning resources, institutions and the distribution of responsibility.

The risks examined in this section demonstrate why the development of a Post-Settlement Civilisation cannot be assessed as a technological project alone. Its viability will depend on how human societies govern the conditions under which people move, remain and belong.

8.10 Strategic Implications

The scenarios developed in TEOS 2100 do not establish which future will emerge by the end of the twenty-first century. Environmental conditions, political decisions and technological developments will interact in ways that cannot be predicted with certainty. Nevertheless, the analysis identifies vulnerabilities that are already relevant to public policy.

Water systems cross administrative boundaries. People move between regions for employment, education and family reasons. Public services remain closely connected to established places of residence, while environmental change can alter the conditions under which settlements remain viable. These relationships create a practical responsibility for institutions planning beyond immediate electoral and investment cycles.

Governments, municipalities, regional organisations and civil society cannot determine the future distribution of human populations in advance. They can, however, improve their ability to respond to changing circumstances. The strategic implications of TEOS 2100 concern the development of that capacity.

They do not require governments to assume that permanent settlements will disappear or that large-scale migration will become inevitable. They require institutions to consider how people can maintain secure lives when environmental conditions, economic opportunities and patterns of residence change.

1. Include mobility in long-term public planning

Population movement is often addressed through migration policy, disaster response or labour-market administration. These functions remain necessary, but they do not cover all the ways mobility influences settlement and infrastructure. Changes in population distribution affect housing, water demand, transport, energy systems and the capacity of public services.

Long-term planning should therefore consider alternative patterns of residence rather than rely exclusively on assumptions of stable population distribution. For governments, this means examining how environmental change and economic developments could influence movement between regions. For municipalities, it means assessing whether infrastructure can accommodate increases or decreases in population without substantial disruption.

Such assessments should not be based on one expected migration pathway. They should examine different plausible conditions, including circumstances in which populations remain, relocate gradually or move repeatedly between locations. The four scenarios in Chapter 6 provide a framework for considering these alternatives.

They demonstrate that population movement can occur under restrictive, cooperative or predominantly market-based institutional arrangements. The consequences for public services differ substantially between these possibilities. Planning should therefore consider the institutions governing movement as well as its potential scale.

2. Strengthen the continuity of rights across jurisdictions

A person's legal status and recognised entitlements can become difficult to maintain when residence or employment changes. This problem already affects people moving between regions and countries. It may become more significant where environmental pressures contribute to prolonged or repeated mobility.

Governments should examine the administrative and legal barriers that interrupt access to education, healthcare, employment and social protection. Mutual recognition of qualifications, coordination of social insurance and reliable access to personal records can reduce some of these barriers.

However, technological compatibility cannot substitute for legal recognition. An electronic record may establish that a person possesses a qualification without granting the right to practise a regulated profession. Similarly, transferable medical information does not guarantee access to healthcare.

The strategic task therefore involves identifying which rights can be maintained across jurisdictions, which require agreements and which remain dependent on national or local legislation. Political participation must be included in this examination.

People maintaining lives in several jurisdictions may retain citizenship rights in one country while being affected by decisions made elsewhere. Accessible external voting procedures, opportunities for local participation and consultation concerning shared resources can address aspects of this problem.

Chapter 5.1 demonstrated that the relationship between citizenship, residence and affectedness requires attention as mobility patterns change. The objective is not to create one universal system of rights independent of states. It is to reduce unnecessary interruptions and clarify the responsibilities of the institutions involved.

3. Develop adaptable public services and infrastructure

Public services are usually organised around relatively stable patterns of residence. Schools, healthcare facilities and administrative offices serve defined geographical areas. These arrangements remain appropriate for many communities. However, institutions may require greater flexibility where demand changes rapidly or where populations live temporarily in several locations.

Modular facilities, mobile service units and digital coordination can provide additional options. A temporary healthcare facility may support an area experiencing a sudden increase in population. Mobile education services can help maintain learning during displacement or repeated movement. Adaptable water and energy systems may provide essential services while permanent infrastructure is expanded or repaired.

The suitability of such arrangements depends on local conditions. Mobile services should not become a substitute for adequate permanent infrastructure where stable provision is possible. Nor should digital access become the only way to obtain public services.

The strategic value of adaptable infrastructure lies in its ability to maintain continuity during change. Governments and service providers should therefore assess which functions require permanent facilities and which could benefit from modular or distributed capacity. Maintenance, operating costs and accessibility must be considered alongside initial investment.

4. Treat water and food security as connected planning responsibilities

The environmental changes examined in TEOS 2100 are closely connected to water availability. Changes in seasonal runoff, extreme events and long-term glacier retreat can influence agriculture, energy production and the reliability of water infrastructure.

Their consequences extend beyond individual settlements. River basins connect upstream and downstream communities, while food systems link production areas with distant consumers. Planning should therefore consider water and food security through their wider geographical relationships.

For the Hindu Kush Himalayan region, this includes the monitoring of water availability, cooperation between relevant authorities and investment in infrastructure suited to changing conditions. Agricultural adaptation may involve changes in irrigation, crop selection and the management of soil and water resources.

Distributed treatment, storage and local food production can provide supplementary capacity where appropriate. However, technological systems cannot create unlimited resources. Their usefulness depends on the availability of water, energy, materials and technical support. Governance is therefore central.

Institutions must establish procedures for allocating resources, addressing competing claims and considering the effects of decisions on other communities. Adaptation measures should also account for the ecological consequences of expanding production or infrastructure. The planetary boundaries framework examined in Chapter 8.6 demonstrates why local improvements must be considered alongside wider environmental pressures.

5. Prepare regional agreements for sustained mobility

Movement across national borders requires cooperation between sovereign states. Existing agreements concerning labour, residence and social protection provide experience that may be relevant to environmental mobility. However, these arrangements differ in their purposes and legal scope. They cannot automatically accommodate every form of climate-related displacement.

Governments and regional institutions can begin by identifying where existing legal pathways and administrative procedures may be insufficient. This includes questions concerning the recognition of qualifications, access to healthcare, family reunification and the responsibilities of receiving authorities. The implications for municipalities should form part of these negotiations.

Agreements establishing movement rights need corresponding arrangements for financing and providing essential services. Without this coordination, commitments made at national

level may create obligations that local administrations cannot fulfil. Regional cooperation is also relevant to shared environmental systems.

River-basin management, early warning and infrastructure planning can require arrangements extending beyond individual national jurisdictions. These forms of cooperation need not depend on the establishment of new political authorities. They may involve strengthening existing institutions and clarifying responsibilities.

For TEOS 2100, the purpose of regional agreements is to create more predictable conditions under which people and institutions can respond to change.

6. Establish accessible participation and conflict-resolution procedures

Environmental adaptation can create competing claims on land, water, public services and financial resources. These disagreements are not necessarily indications that cooperation has failed. They are often consequences of legitimate interests that cannot all be satisfied in the same way.

Public institutions need procedures through which these interests can be considered. Participation should begin before major decisions have become effectively irreversible. Affected communities require access to relevant information and opportunities to present concerns. Administrative review, mediation and judicial remedies may be necessary where decisions are disputed. The appropriate procedures depend on the authority involved and the legal framework.

However, the underlying requirement remains that individuals should be able to understand and challenge decisions affecting their rights. This applies to relocation programmes as well as resource management. A community asked to move because of environmental risks should be able to examine the evidence and proposed alternatives. A receiving municipality should have opportunities to address the infrastructure implications of population changes.

People entering a resource cooperative should understand how membership and allocation decisions are made. The Water Assembly presented in Chapter 7 illustrates how these problems might be addressed locally. Its procedures do not eliminate disagreement. They provide a means of making decisions despite it.

For TEOS 2100, the capacity to manage conflict is therefore part of the infrastructure required for adaptation.

7. Adapt education and professional development to changing conditions

Environmental and institutional change can alter the tasks people perform in their occupations. Agriculture, construction, infrastructure maintenance and public administration may require new approaches as resource availability and settlement conditions change.

Healthcare and education systems may need to serve populations whose lives extend across several locations. Digital technologies can support these activities, but their use requires professional judgement and practical knowledge. Education should therefore address the ability to act under changing conditions. This includes understanding resource

systems, assessing risks and making decisions where environmental, economic and social interests interact.

Professional development may also need to support people moving between occupations or regions. Recognised qualifications and opportunities for continued learning can help maintain livelihoods during such transitions. However, learning should not be treated solely as an individual responsibility. Institutions must provide access to education and ensure that qualifications remain meaningful within the relevant legal and professional frameworks.

For TEOS 2100, the central issue is the development of professional and civic capabilities suited to increasingly interconnected systems. People may need to work with colleagues from different backgrounds, understand the consequences of resource use and participate in decisions affecting their communities. These capabilities are relevant whether individuals remain in one location or move between several.

8. Prioritise repairability, interoperability and accountable technology

Technology can improve the adaptability of public services and infrastructure. Modular housing, distributed energy, water treatment and digital records may support communities experiencing changing conditions. However, technologies should be assessed according to their practical usefulness over time.

Systems requiring specialised maintenance or replacement components that cannot be obtained locally may create new dependencies. Interoperability can improve coordination between organisations, but it also requires agreed technical standards and clear responsibilities.

Repairability is relevant to the continuity of essential services. Equipment that can be maintained with available skills and components may provide greater resilience than systems that depend on continuous external support. Environmental performance must also be considered across production, operation and disposal. The use of materials and energy should be assessed alongside the benefits of improved efficiency. Digital systems require additional safeguards. Their ability to exchange information should not eliminate individuals' control over personal data.

Decisions affecting access to employment, public services or legal status must remain subject to appropriate review. Governments and organisations procuring essential infrastructure should therefore consider accountability, accessibility and long-term maintenance as part of technological performance. Technical innovation is most useful when it strengthens the capacity of people and institutions to respond to disruption without creating unnecessary dependence.

9. Connect space research with terrestrial adaptation

Human activities in space provide experience with the operation of complex technical systems under restrictive conditions. Research concerning water recovery, environmental control, remote maintenance and resource efficiency may offer insights relevant to terrestrial applications. However, the practical value of these approaches must be established under the conditions in which they would be used.

Technologies developed for spacecraft can involve costs and operating requirements that make them unsuitable for many communities on Earth. Their relevance should therefore be evaluated through testing and appropriate assessment rather than assumed. The relationship also operates in the other direction. Terrestrial experience with public administration, social protection and shared resource governance may inform consideration of future human habitation beyond Earth.

Space programmes increasingly involve partnerships between public agencies and private organisations. Long-term habitation, if it develops, could raise questions concerning employment, political participation and responsibility for essential services. These questions should be considered before institutions become dependent on arrangements that are difficult to change. The strategic implication is not that Earth must prepare for an inevitable migration into space.

It is that research and institutional development can benefit from examining problems across different environments while recognising the limits of comparison.

10. Strengthen social relationships and the conditions of belonging

Mobility can change the relationships through which people identify with places and communities. Relocation may separate households from established support networks. Receiving communities may experience rapid social change, while newcomers encounter unfamiliar institutions and cultural expectations.

Public policy often addresses these developments through housing, employment and access to services. These measures are necessary, but they do not fully address the social consequences of movement. People also need opportunities to form relationships, participate in community life and maintain connections to places of origin.

Civil society organisations, local associations and cultural institutions can support these processes. Their contribution may include communication between established residents and newcomers, assistance with navigating institutions and opportunities for participation in local activities.

However, belonging cannot simply be provided through a public programme. It develops through relationships and experiences over time. Institutional arrangements can nevertheless influence whether these relationships are possible. Rules that systematically exclude newcomers from participation may limit their ability to become part of a community.

Similarly, relocation policies that disregard existing cultural and social relationships may impose losses that material compensation cannot adequately address. For TEOS 2100, social continuity should therefore be considered alongside physical safety and economic security.

A society capable of accommodating mobility must preserve opportunities for people to belong, whether they remain in established settlements or develop lives across several locations.

Priorities for action

The ten strategic areas described above differ in their time horizons and institutional requirements. Some concern vulnerabilities that already exist and can be addressed through established policy processes. Others involve possible developments whose scale and significance remain uncertain. This distinction is relevant to decisions about investment and institutional reform.

Improving access to public services, strengthening environmental monitoring and clarifying administrative responsibilities can produce benefits under several different futures. Such measures do not require a prediction that a particular volume of migration will occur. Similarly, improving the recognition of qualifications or access to administrative review can benefit existing mobile populations while creating capacity for future change.

More extensive arrangements, such as new regional mobility agreements or revised systems of political representation, would require negotiation and political legitimacy. They should be developed in response to identified needs and evidence rather than treated as inevitable steps towards a predetermined form of society. Long-term planning also requires mechanisms for reviewing decisions.

Environmental observations, demographic developments and experience with adaptation programmes should inform changes in policy. Institutions need the capacity to recognise when their assumptions no longer correspond to conditions on the ground.

The purpose of foresight is to support this capacity. It does not remove uncertainty, but it can help institutions examine the consequences of different choices before those choices become difficult to reverse.

Responsibilities across institutional levels

The strategic implications of TEOS 2100 cannot be assigned to one category of organisation. National governments possess responsibilities concerning legislation, public finance and international agreements. Regional institutions can coordinate issues extending across borders. Municipalities provide many of the services affected by population changes and settlement pressures.

Research organisations contribute observations, assessments and knowledge about possible developments. Businesses develop and operate infrastructure and services, while civil society organisations can support participation and represent interests that might otherwise receive limited attention.

These responsibilities overlap. Effective adaptation therefore depends on coordination between institutions with different mandates and capacities. However, cooperation should not obscure accountability. Each institution must remain answerable for decisions within its authority.

The existence of several participating organisations does not relieve any of them of responsibility for commitments it has undertaken. For TEOS 2100, this is central to the development of governance capable of operating across changing relationships between population and territory.

Strategic implications for TEOS 2100

The analysis presented in this report supports a shift in the way long-term settlement policy is considered. Traditional planning often begins with the assumption that populations, infrastructure and public responsibilities remain associated with relatively stable geographical areas. This assumption continues to be appropriate in many circumstances.

However, environmental change and existing patterns of economic and social mobility demonstrate that it cannot be treated as universal. Public institutions should therefore prepare for a wider range of relationships between people and places. This preparation includes maintaining the viability of settlements where adaptation is possible.

It includes ensuring that people can relocate safely when remaining becomes untenable. It also involves recognising that mobility may occur repeatedly or across several jurisdictions without requiring individuals to abandon their previous social and legal relationships. The effectiveness of these arrangements will depend on political participation, accessible rights and the management of shared resources. Technological improvements can support these objectives, but they cannot determine how responsibilities should be allocated or whose interests should prevail.

The strategic purpose of TEOS 2100 is therefore not to advocate movement over settlement. It is to encourage institutions to examine how the conditions supporting human life can remain secure as environmental and social circumstances change. A settlement may remain viable through adaptation. Another may require gradual relocation. A household may establish a livelihood across several locations.

Each situation demands different practical responses. The common requirement is the ability of institutions to recognise these differences and respond without unnecessarily disrupting people's rights and relationships. Planning for the future of settlement should therefore begin with the conditions that allow people to live securely, participate in society and make meaningful decisions about where and how they live.

Those conditions should guide institutional development regardless of the settlement patterns that emerge by 2100.

8.11 Closing Reflection: The End of Settlement Is Not the End of Belonging

For much of human history, the places people inhabited shaped the organisation of their lives. Settlements provided shelter, access to resources and the foundations of economic activity. Over generations, they became associated with institutions, memories, relationships and cultural practices.

A place could become home because people lived there together, worked the same land, shared responsibilities and passed their experiences to those who came after them. These relationships were never entirely static. People travelled, migrated and maintained connections beyond their immediate communities. Societies changed as populations moved and new relationships emerged.Yet per manent settlements provided continuity. They offered familiar environments in which institutions could develop and relationships could endure.

TEOS 2100 began by questioning the environmental conditions supporting that continuity. The glaciers of the Hindu Kush Himalaya are changing. Their retreat is altering landscapes and contributing to changes in the water systems on which communities depend. The consequences extend through agriculture, energy production, livelihoods and the wider relationships connecting mountain regions to downstream populations.

These changes do not establish that settlement in the region will come to an end. They do, however, challenge the assumption that existing settlement patterns can remain viable indefinitely without adaptation. Some communities may continue living in their established locations through investments in infrastructure and changes in resource management. Others may face circumstances that make relocation increasingly difficult to avoid.

For many households, decisions will be less clear. People may remain attached to places whose economic foundations have weakened. They may move for work while maintaining family responsibilities elsewhere. They may leave with the intention of returning, only to discover that the conditions for doing so have changed. Such experiences cannot be understood through the movement of populations alone.

A settlement is more than a geographical location. It is part of the social environment through which people develop relationships, recognise responsibilities and understand their place in the world. When that environment changes, people may lose things that cannot readily be replaced through new housing or employment.

Land may carry memories extending across generations. A community may preserve a language or cultural practice whose continuity depends on relationships between its members. Familiar institutions may provide forms of support that become visible only when they are no longer available.

The loss of a place can therefore involve more than physical displacement. At the same time, belonging does not have to remain confined to a single location. People can establish relationships across borders, maintain cultural connections over distance and participate in communities that extend beyond their immediate place of residence.

Families may preserve ties to places of origin while developing lives elsewhere. New communities may emerge through shared work, mutual assistance and the experience of living together. These relationships are not necessarily weaker because they extend across several places.

Their continuity depends on the opportunities people possess to maintain them. For TEOS 2100, this is a central distinction.

Mobility does not automatically dissolve belonging. Nor does remaining in one place guarantee it. A person may live for decades in a community without obtaining meaningful opportunities to participate in its decisions. Another may maintain strong relationships with people in several countries while possessing recognised rights and responsibilities in each.

The conditions of belonging are therefore shaped by institutions as well as personal relationships. Citizenship, residence and participation provide different forms of connection between individuals and political communities. As patterns of movement change, these connections may no longer coincide.

A person may retain the nationality of a state in which they no longer live. They may work and raise a family in another country while having limited influence over local decisions. Their livelihood may depend on resources managed beyond either jurisdiction. These circumstances raise questions that cannot be resolved by transport or digital communication. They concern the ways societies recognise individuals and the responsibilities they share.

A future in which people move more frequently or maintain lives across several locations would require institutions capable of accommodating these relationships. Such institutions would need to preserve recognised rights, provide access to essential services and create meaningful opportunities for participation. They would also need to address the interests of communities whose members wish to remain.

Adaptation cannot be reduced to the movement of people away from environmental pressure. For some, the most important opportunity will be to relocate before living conditions deteriorate further. For others, it will be the ability to continue living in a familiar place without being exposed to unacceptable risks or losing access to essential services. Both choices involve questions of security and belonging.

The right to move has limited meaning when no viable destination is available. The ability to remain is equally limited when the conditions required for everyday life can no longer be maintained. The future of settlement must therefore be considered through the choices available to people, rather than through an assumption that permanent residence or continuous mobility represents the preferred form of human life.

The four futures developed in this report illustrate how differently societies might respond. Their significance lies less in the geographical patterns they describe than in the relationships they establish between people, institutions and resources.

A protected settlement may offer safety while denying access to those outside its boundaries. An international mobility agreement may provide recognised rights while leaving receiving communities without sufficient resources to fulfil their obligations. A digital employment network may enable people to work across considerable distances while limiting their influence over the conditions of their employment. A community managing its resources collectively may develop effective procedures for cooperation while struggling to accommodate newcomers.

These are not problems that can be solved once and for all. They are questions that societies must continue to address as their circumstances change. The Human Stories in Chapter 7 placed individuals within these possible futures. Their characters made decisions under conditions they had not chosen. Some sought permission to move. Others struggled to remain. Several attempted to fulfil responsibilities that existing institutions did not adequately recognise.

Their experiences remind us that the consequences of large-scale change are ultimately encountered in ordinary situations. A person needs to reach a place of work. A child needs access to education. A family must decide whether to leave its home. A community must allocate water when there is insufficient supply to meet every demand. The institutions governing these circumstances influence whether people can maintain a secure and meaningful place in society.

Their effectiveness cannot be measured solely through the number of people they serve or the infrastructure they provide. It also depends on how they treat those whose circumstances do not fit established categories. This becomes relevant when considering human life beyond Earth.

The possibility of long-term habitation in orbital facilities or on other celestial bodies extends the geographical horizon of human activity. Yet the presence of advanced technology would not remove the need for people to establish relationships, share responsibilities and participate in decisions.

A facility capable of sustaining human life would still have to address the conditions under which its inhabitants live together. Its residents might possess nationalities, cultural backgrounds and social relationships extending across extraordinary distances. Their everyday lives would depend on infrastructure operated through complex institutional arrangements.

The technical environment would differ fundamentally from any settlement on Earth. The question of belonging would remain.

This does not make the future of human settlement beyond Earth a continuation of climate-related migration. Nor does it suggest that the environmental problems examined in TEOS 2100 will drive humanity towards the stars. The connection lies in the wider question of how societies maintain continuity when familiar relationships between people and places change.

That question already exists on Earth. It can be examined through the institutions governing migration, through communities managing shared resources and through the rights of people whose lives extend across several jurisdictions. The answers will emerge, if at all, through political decisions, social experience and the continuing development of institutions. They cannot be supplied by technology alone.

The future examined in TEOS 2100 remains uncertain. The scale and distribution of environmental change will depend on developments extending well beyond the Hindu Kush Himalaya. Societies will respond according to circumstances that cannot be fully anticipated. Some settlements will adapt. Others may change fundamentally or cease to provide viable places to live. New relationships between communities may emerge, while existing ones become difficult to maintain.

The concept of a Post-Settlement Civilisation offers one way of examining these possibilities. It does not describe a world without homes, villages or cities. It describes the possibility that social life may become less dependent on the assumption that each person belongs permanently to one place. Whether such a development expands human freedom or creates new forms of insecurity will depend on the institutions societies establish.

The distinction matters because the future of settlement is not only an environmental or technological question. It is also a question of who can belong, who can participate and who bears responsibility for others.

TEOS 2100 began in the mountains of Asia, where changing glaciers reveal the vulnerability of landscapes that have supported human communities for generations. It ends with the

recognition that the places people inhabit may change more rapidly than the institutions through which they organise their lives. Those institutions can change as well.

The end of settlement, understood as the end of an unquestioned dependence on permanent residence, need not mean the end of belonging. What remains open is whether societies will develop the capacity to preserve that belonging as the conditions of human life continue to change.

Methodological Annex

A.1 Purpose and methodological approach

TEOS 2100 is an interdisciplinary foresight study examining how long-term environmental change could influence human settlement, mobility and social organisation by the end of the twenty-first century. Its geographical starting point is the Hindu Kush Himalayan region, where changes in glaciers, snow cover, river systems and water availability create environmental pressures with potential consequences extending across large parts of Asia.

The study does not seek to predict a particular pattern of settlement or political organisation in 2100. Its purpose is to explore how environmental change could interact with economic developments, population movements, technological capabilities and institutional decisions to produce different social outcomes.

The methodological approach combines the interpretation of existing scientific evidence with qualitative scenario analysis and fictional narratives. These elements serve different functions.

Scientific research provides information about observed environmental and social processes. Published projections help identify possible future conditions under specified assumptions. Scenario analysis explores alternative institutional responses to uncertainty. Fictional narratives examine how those responses might affect individual lives.

The report maintains a distinction between these forms of knowledge. Its contribution lies in examining relationships between developments commonly addressed in separate research and policy fields. It does not produce new measurements of environmental change, estimate future migration flows or calculate the probability of a particular social transformation.

A.2 Evidence base and source selection

The analysis draws on published research and institutional assessments concerning climate change, mountain environments, water security, agriculture, energy production, migration, demography, governance and technological development. The evidence base includes peer-reviewed scientific publications, reports from international organisations, official statistical projections, legal instruments and relevant policy documents.

Major sources include assessments by the Intergovernmental Panel on Climate Change (IPCC), the International Centre for Integrated Mountain Development (ICIMOD), United Nations organisations and the World Bank. Other sources are used where they provide information concerning specific regional developments, institutions or technologies.

The report also considers recent events and policy developments relevant to the conditions examined in its scenarios. Sources are selected according to their relevance to the question being examined, the credibility of the issuing organisation and the extent to which their findings can be interpreted within the report's geographical and temporal scope.

Different sources serve different purposes.

- Peer-reviewed research and scientific assessments provide evidence concerning environmental processes and observed relationships.
- Official statistical publications provide demographic and socioeconomic context.
- Legal instruments and institutional documents establish the current arrangements governing migration, political authority and access to rights.
- Policy announcements and programme descriptions provide information about planned activities. They do not establish that those activities will be completed or achieve their intended outcomes.

Where published information concerns a rapidly developing event, the report distinguishes between preliminary assessments and established findings. Scientific uncertainty is retained where it affects the interpretation of the evidence.

The study is based on a selected interdisciplinary body of literature. It is not a systematic review conducted through a predefined database search protocol, nor does it claim exhaustive coverage of every relevant publication. The sources supporting specific factual statements are identified in the corresponding sections and footnotes.

A.3 Interpretation of environmental evidence

The environmental analysis in Chapter 2 focuses on the relationship between changing mountain water systems and the conditions supporting human settlement. Glacier retreat, snow cover, precipitation, river discharge and mountain hazards are examined as interconnected processes. The report distinguishes between changes in glacier mass and changes in the availability of water for particular human uses.

Glacier retreat does not necessarily produce a continuous reduction in river discharge. In some catchments, increased melting may temporarily raise runoff. Over longer periods, the decline in stored ice can reduce glacier contributions to river flows. The consequences also depend on rainfall, seasonal snowmelt, groundwater and water management. This distinction is maintained throughout the analysis.

The term *Himalayan water collapse* is used as a conceptual description of a possible long-term deterioration in the reliability of water systems. It does not refer to a single catastrophic event or the complete disappearance of freshwater. The report does not apply an independent hydrological model. Its environmental assumptions are derived from published research and assessments, whose geographical coverage, reference periods and projection conditions vary.

Quantitative findings are therefore interpreted in relation to the definitions and limitations of their original sources. Evidence concerning individual river basins or local communities is not treated as automatically representative of the entire Hindu Kush Himalayan region.

The analysis also distinguishes between environmental hazards and their social consequences. A flood, drought or landslide may damage infrastructure and livelihoods, but its effects on settlement depend on exposure, economic resources and institutional capacity. The transition from environmental change to social disruption is therefore examined as a conditional relationship rather than a fixed sequence of events.

A.4 Use of demographic and socioeconomic projections

TEOS 2100 uses demographic projections to illustrate the possible future scale of populations living in countries connected to Himalayan river systems. The country-level population figures discussed in Chapter 1 are based on the United Nations World Population Prospects 2024, using the medium projection variant.

The combined estimate of approximately 3.0 to 3.3 billion inhabitants by 2100 describes the demographic context of the countries included in the assessment. It does not represent the number of people who depend directly on glacier meltwater. Nor does it indicate how many people may experience water insecurity, displacement or migration because of environmental change.

The countries considered contain different ecological zones, river basins, economic systems and populations. Exposure to Himalayan-linked water insecurity varies considerably within and between them. The report therefore avoids deriving migration estimates from aggregate country populations.

Socioeconomic indicators are treated similarly. Figures concerning agricultural dependence, infrastructure damage, energy production, employment or remittances describe the circumstances and periods examined in their original sources. They are used to identify relationships between environmental change and economic activity. They are not extended mechanically to the year 2100.

Where projections or published estimates are included, their underlying assumptions remain relevant to interpretation. TEOS 2100 does not develop an independent population model, economic forecast or integrated assessment model.

A.5 Relationship between environmental change and mobility

The study does not assume that environmental change produces a direct or uniform migration response. Movement is understood as a process influenced by several interacting conditions. These include livelihoods, household income, social relationships, access to infrastructure, political circumstances and legal opportunities.

Environmental pressures may influence these conditions without being the sole cause of a decision to relocate. The report therefore distinguishes between internal and international migration, disaster displacement, planned relocation, seasonal movement and livelihoods maintained across several locations.

It also considers immobility. Some people remain because they wish to preserve established relationships and livelihoods. Others may be unable to move because of financial constraints, physical limitations, care responsibilities or restricted legal opportunities. These situations cannot be adequately represented through migration statistics alone.

The analysis accordingly treats the ability to move and the ability to remain as related dimensions of human security. No numerical estimate of climate-related migration to 2100 is produced. The scenarios explore how different institutional arrangements could influence the conditions under which movement takes place.

A.6 Construction of the four scenarios

Chapter 6 develops four exploratory scenarios using a qualitative approach based on two critical uncertainties. The first concerns governance and access to rights. It ranges from predominantly territorial and exclusionary arrangements to more coordinated and inclusive forms of institutional cooperation. The second concerns the dominant approach to adaptation. It ranges from greater emphasis on maintaining viable settlements through place-based measures to increased reliance on mobility and livelihoods organised across several locations.

These dimensions provide the analytical basis for the scenario matrix presented in Figure 6. Their combination generates four contrasting futures.

Fortress Earth combines predominantly exclusionary territorial governance with a strong emphasis on protecting selected established settlements.

Negotiated Mobility combines coordinated institutional arrangements with greater reliance on migration, circular movement and multi-local residence.

Networked Nomads combines extensive mobility with fragmented or unevenly inclusive governance, in which private networks and digital platforms play substantial roles.

Planetary Transition combines coordinated and inclusive governance with greater emphasis on preserving or restoring the viability of settlements through adaptation and shared resource management.

The dimensions were chosen to make differences in institutional responses visible. They do not represent independent quantitative variables. Nor do they include every development that could shape future societies. Technological change, geopolitics, economic inequality, demographic developments and cultural relationships may influence outcomes in ways that extend beyond the two-dimensional framework.

The scenarios are therefore constructed as coherent alternatives for comparison. They are not mutually exclusive descriptions of the entire world. Different regions could experience elements of several scenarios simultaneously or move between institutional arrangements over time. The four scenarios are not ranked according to probability.

A.7 Common assumptions and time horizon

All four scenarios share a broad environmental starting condition. They assume that changes in Himalayan water systems and associated environmental pressures continue to influence settlement viability in parts of the region during the twenty-first century. This does not imply that every river basin experiences identical changes or that all settlements become uninhabitable.

The geographical and economic consequences remain dependent on environmental developments, infrastructure, available resources and institutional responses. The year 2100 provides the common horizon.

Each scenario is examined through four broad periods:

- **2026-2040:** Emerging pressures, policy choices and institutional responses.
- **2041-2060:** Consolidation or revision of initial approaches.
- **2061-2080:** Consequences for economic systems, population distribution and institutional relationships.
- **2081-2100:** The resulting social and institutional conditions examined in each scenario.

These periods are narrative and analytical devices. They are not forecasts of when particular environmental, economic or political thresholds will be crossed. The chronological structure helps examine how earlier decisions might influence later possibilities. It does not assume that institutional development proceeds without interruption.

Political agreements may fail, technological programmes may change and communities may adopt responses that differ from those initially anticipated. The scenarios therefore remain conditional accounts of possible developments.

A.8 Criteria for scenario comparison

The four scenarios are examined through a common set of questions to make their consequences comparable. The framework developed in Chapter 6.1 identifies seven areas:

1. **Settlement and resource access:** The viability of places and the allocation of housing, land, water and essential infrastructure.
2. **Governance and rights:** The distribution of decision-making authority, political representation and access to legal remedies.
3. **Education and healthcare:** The continuity of essential services across changes in residence and legal status.
4. **Livelihoods and economic security:** Access to employment, income and social protection.
5. **Mobility and residence:** The ability to remain, move temporarily or relocate without unnecessary loss of rights.
6. **Social belonging:** Relationships between established residents, newcomers and communities extending across several locations.
7. **Technology and infrastructure:** The availability, reliability and governance of systems supporting everyday life.

These criteria allow the scenarios to be assessed through the circumstances experienced by individuals and communities. The central concern is human viability. A settlement may remain physically accessible while its inhabitants lack adequate livelihoods or essential services. A population may possess extensive opportunities for movement while remaining excluded from political participation or social protection.

The comparison therefore considers access, security and accountability alongside technical capabilities. It also examines inequalities within scenarios. Individuals do not experience an institutional arrangement in the same way. Citizenship, property ownership, income, qualifications, health and family responsibilities may influence access to resources and services.

The comparison does not reduce a scenario to the average conditions of its population. It considers who can benefit from institutional arrangements and who may remain excluded. The analysis is qualitative. It does not construct numerical indices or assign weighted scores to the seven criteria.

A.9 Development and function of the Human Stories

Chapter 7 uses fictional narratives to examine the human consequences of the four scenarios. Two individual perspectives are associated with each scenario, followed by a synthesis of the relationships between them. The stories are constructed from the institutional conditions described in the scenario analysis.

They place characters in situations involving employment, public services, access to resources, family responsibilities or political membership. Their decisions are shaped by the rules and limitations of the society in which they live. The narratives are not empirical case studies. They do not represent interviews with future populations or findings derived from observed events.

Their function is interpretative. They make institutional arrangements more tangible by showing how these arrangements might affect particular individuals. They also provide an opportunity to examine the internal consistency of the scenarios. A fictional situation may reveal a question that remains insufficiently addressed by the wider institutional account.

For example, a mobility arrangement may appear effective at the level of international agreements while leaving unclear how a receiving municipality provides housing and services. A digitally connected employment system may enable professional mobility while creating difficulties for individuals with continuous care responsibilities. A community managing water collectively may require additional procedures for recognising the claims of newcomers.

These situations help explore the consequences of the scenario assumptions. They do not independently validate those assumptions or establish that a particular future is likely. The fictional narratives remain clearly separated from the scientific evidence presented elsewhere in the report.

A.10 Interpretation of strategic implications

The strategic implications developed in Chapter 8 are derived from the relationships examined across the environmental analysis, institutional discussion and scenarios. They identify areas in which present-day institutions may benefit from preparing for different possible futures. These include infrastructure planning, the continuity of rights and services, regional cooperation, resource governance, education, technological resilience and political participation.

The recommendations do not depend on one scenario becoming reality. Some concern vulnerabilities already observable within existing institutions. Others address possible future needs that would arise if mobility and changing settlement patterns became more significant.

The study does not apply a formal cost-benefit analysis or rank the recommendations according to quantified effectiveness. Nor does it establish the legal or financial feasibility of every possible institutional arrangement. The strategic implications should therefore be understood as areas for consideration, further investigation and policy development. Their implementation would require additional assessment appropriate to the institutions and locations concerned.

A.11 Scope of the longer-term space perspective

Chapter 8 extends the analysis to the possibility of sustained human activity beyond Earth. This perspective is included to examine broader questions concerning mobility, technical dependence, resource constraints and institutional responsibility. It is not used to predict that environmental change on Earth will lead to large-scale settlement in space.

Current space programmes and life-support technologies provide evidence of capabilities developed for research and exploration. Plans for future lunar or Martian activities are considered according to their documented status and should not be treated as completed achievements. The comparison between terrestrial adaptation and extraterrestrial habitation is conceptual.

Both may involve questions about resource allocation, the continuity of essential services and the relationship between inhabitants and institutions located elsewhere. Their physical conditions, economic requirements and legal frameworks differ substantially. The report therefore does not infer the feasibility of permanent space settlements from the existence of technologies used in remote or mobile communities on Earth. Nor does it assume that extraterrestrial resource use could remove the need to address planetary environmental pressures.

The space perspective serves to clarify the distinction between technical capability and the institutions necessary to maintain human life over extended periods.

A.12 Methodological limitations

Several limitations determine how the findings of TEOS 2100 should be interpreted.

Environmental uncertainty. Published projections describe possible developments under specified assumptions. Their implications differ between river basins, locations and time periods. The report does not independently model these processes.

Socioeconomic complexity. Environmental change interacts with employment, infrastructure, demographic developments, institutions and political decisions. These relationships cannot be represented as a simple causal sequence.

Limits of demographic interpretation. Country-level population projections establish demographic context but do not identify the number of people directly exposed to Himalayan water insecurity or expected to migrate.

Qualitative scenario construction. The four futures are coherent exploratory constructions rather than probabilistic forecasts. Their differences depend on selected dimensions of uncertainty, which simplify a wider range of possible developments.

Geographical diversity. The Hindu Kush Himalayan region and its connected river basins encompass different environmental conditions, economies, political systems and communities. The scenarios cannot represent every local development.

Institutional uncertainty. Legal frameworks, political relationships and economic systems may change in ways that cannot be anticipated. The institutional arrangements described for 2100 are possible constructions rather than established outcomes.

Narrative interpretation. The Human Stories are fictional and do not constitute empirical evidence. They are used to examine implications and internal consistency.

Source coverage. The report draws on selected interdisciplinary literature and institutional sources. It is not an exhaustive systematic review. The availability and quality of evidence vary between topics and regions.

Temporal scope. The year 2100 provides a shared horizon for examining long-term relationships. The study does not predict the timing of individual political or institutional transformations.

These limitations do not invalidate the use of foresight. They establish the boundaries within which the analysis can contribute to research, public discussion and institutional planning.

A.13 Interpretation and use of the report

TEOS 2100 should be read as an exploration of possible relationships between environmental change, human mobility and institutional development.

- Its scientific sources provide evidence concerning existing conditions and processes.
- Its projections describe possible developments under specified assumptions.
- Its scenarios examine contrasting responses to uncertainty.
- Its fictional narratives explore the consequences of those responses for individual lives.

The report does not establish that a Post-Settlement Civilisation will emerge by 2100. It considers such a development plausible enough to warrant examination, while recognising that societies may continue to maintain extensive permanent settlements through adaptation and institutional change.

The concept of *Post-Settlement Civilisation* is therefore an analytical perspective rather than a predetermined destination. Its usefulness lies in making visible questions that may otherwise remain divided between environmental science, migration research, public administration and political theory. These questions concern the ability of people to remain in viable communities, relocate when necessary and maintain recognised rights and relationships across changing locations.

The scenarios provide no definitive answer. They allow readers to examine how different institutional choices could affect those possibilities. The principal contribution of TEOS 2100 is to connect the environmental foundations of settlement with the political and social conditions through which people organise their lives. It offers a framework for considering long-term consequences while acknowledging that the future remains contingent on choices that have yet to be made.