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International Resource Panel

HUMAN MIGRATION AND NATURAL RESOURCES

Global Assessment of an adaptive complex system

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GLOSSARY

Given the scope of this report, many of the terms directly connect with research outputs by the International Resource Panel (IRP) and the International Organization for Migration (IOM). To continue the synergy of this work, much of the glossary is stocked with terms taken from these two institutions, with references and citations.

Adaptation: In the context of this report, adaptation can be seen as an individual, group or societal change in response to ongoing environmental, socioeconomic or political influences.

Assisted migration: The movement of migrants carried out with the assistance of governments or international organizations, as opposed to spontaneous, unaided migration.[1]

Asylum: The protection granted by a State, on its territory, to persons outside their country of nationality or habitual residence, who are fleeing persecution or serious harm, or for other reasons. Asylum encompasses a variety of elements, including non-refoulement, permission to remain on the territory of the asylum country, humane standards of treatment and eventually a durable solution.[1]

Asylum seeker: An individual who is seeking international protection. In countries with individualized procedures, an asylum seeker is someone whose claim has not yet been finally decided on by the country in which he or she has submitted it. Not every asylum seeker will ultimately be recognized as a refugee, but every recognized refugee is initially an asylum seeker.[1]

Circular migration: A form of migration in which people repeatedly move back and forth between two or more countries.[1]

Complex system: A system with dependencies, competitions, relationships between its parts and the environment which can lead to a variety of possible outcomes. While complicated systems can have many parts which act in a predictable way, complex systems have emergent properties which are not predictable. For example a car's machinery is complicated but not complex. However, traffic in a city is complex.

Consumption: The use of products and services for (domestic) final demand, i.e. for households, government and investments. The consumption of resources can be calculated by attributing the life-cycle-wide resource requirements to those products and services (e.g. by input-output calculation).[2]

Cross-border displacement: The movements of persons who have been forced or obliged to leave their homes or places of habitual residence and move across international borders.[1]

Diaspora: Migrants or descendants of migrants whose identity and sense of belonging, either real or symbolic, have been shaped by their migration experience and background. They maintain links with their homelands, and to each other, based on a shared sense of history, identity, or mutual experiences in the destination country.[1]

Displacement: The movement of persons who have been forced or obliged to flee or to leave their homes or places of habitual residence, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violations of human rights or natural or human-made disasters.[1]

Drivers of migration: Complex set of interlinking factors that influence an individual, family or population group's decisions relating to migration, including displacement.[1]

Economic migration: The movement of a person or a group of persons, either across an international border or within a State, motivated solely or primarily by economic opportunities. The term is widely contested but used in political discourse as such.

Ecosystem services: Functions and processes which ecosystems provide and which affect human well-being. They include (a) provisioning services such as food, water, timber and fibre; (b) regulating services such as the regulation of climate, floods, disease, waste and water quality; (c) cultural services such as recreation, aesthetic enjoyment and spiritual fulfilment; and (d) supporting services such as soil formation, photosynthesis and nutrient cycling.[2]

Emigration: From the perspective of the country of departure, the act of moving out of a location of current residence.

Environmental migration / environmentally induced migration: The movement of persons or groups of persons who, predominantly for reasons of sudden or progressive changes in the environment that adversely affect their lives or living conditions, are forced to leave their places of habitual residence, or choose to do so, either temporarily or permanently, and who move within or outside their country of origin or habitual residence. Note that this term does not have any specific legal value (as yet).[1]

Forced migration: As opposed to voluntary migration. A migratory movement which, although the drivers can be diverse, involves force, compulsion or coercion. While not an international legal concept, this term has been used to describe the movements of refugees, displaced persons (including those displaced by disasters or development projects) and, in some instances, victims of trafficking. At the international level, the use of this term is debated because of the widespread recognition that a continuum of agency exists rather than a voluntary/forced dichotomy and that it might undermine the existing legal international protection regime.[1]

Immigrant: From the perspective of the location of arrival, a person who moves into a country other than that of his or her nationality or usual residence, so that the country of destination effectively becomes his or her new country of usual residence.[1]

Immigration: From the perspective of the country of arrival, the act of moving into a country other than one's country of nationality or usual residence, so that the country of destination effectively becomes his or her new country of usual residence.[1]

Immobility: Where individuals or groups wish to move but are constrained by socioeconomic or political factors that do not allow them to do so. This, along with environmental conditions and hazards, can lead to "trapped populations" (see below).

Internal migrant: Any person who is moving or has moved within a State for the purpose of establishing a new temporary or permanent residence or because of displacement.[1]

Internal migration: The movement of people within a State involving the establishment of a new temporary or permanent residence.[1]

Internally displaced persons (IDPs): Persons or groups of persons who have been forced or obliged to flee or to leave their homes or places of habitual residence, in particular as a result of or in order to avoid the effects of armed conflict, situations of generalized violence, violations of human rights or natural or human-made disasters, and who have not crossed an internationally recognized State border.[1]

Land degradation: The process in which the existing or potential "ecosystem services" (see above) of a given biophysical environment are affected by a combination of processes acting upon the environment.

Land use change: The process of (and the study of the dynamics and consequences of) the conversion of land from one type of use or state to another over a given time period. Typically, we are most concerned with change of land from its naturally occurring (e.g. forest, grassland) or productive (e.g. agriculture) state to a less sustainable or degraded state (see "land degradation" above) via anthropogenic processes.

Long-term migrant: A person who moves to a country other than that of his or her usual residence for a period of at least one year, so that the country of destination effectively becomes his or her new country of usual residence.[1]

Maladaptation: As opposed to "adaptation" (see above). Juhola et al. (2016) defines maladaptation in the context of society-environment interactions as "actions that may lead to increased risk of adverse climate-related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future".

Migrant: An umbrella term, not defined under international law, reflecting the common lay understanding of a person who moves away from his or her place of usual residence, whether within a country or across an international border, temporarily or permanently, and for a variety of reasons. The term includes a number of well-defined legal categories of people, such as migrant workers, persons whose particular types of movements are legally defined, such as smuggled migrants, as well as those whose status or means of movement are not specifically defined under international law, such as international students.[1]

Migration: The movement of persons away from their place of usual residence, either across an international border or within a State.[1]

Net migration: Net number of migrants in a given period, that is, the number of immigrants minus the number of emigrants.

Planned relocation: In the context of disasters or environmental degradation, including when due to the effects of climate change, a planned process in which persons or groups of persons move or are assisted to move away from their homes or place of temporary residence, are settled in a new location, and are provided with the conditions for rebuilding their lives.[1]

Push-pull factors: A model categorizing the drivers of migration into push and pull factors, whereby push factors are those which drive people to leave their country and pull factors are those attracting them into the country of destination. Whilst it provides a useful categorization of reasons for migrating, the "push-pull" model has subsequently been misrepresented in a manner that fails to acknowledge the complexity and interplay of the factors that lead to the decision to migrate.[1]

Refugee: As per the 1951 Convention, a person who, owing to a well-founded fear of persecution for

reasons of race, religion, nationality, membership of a particular social group or political opinion, is outside the country of his or her nationality and is unable or, owing to such fear, is unwilling to avail himself or herself of the protection of that country; or a person who, not having a nationality and being outside the country of his or her former habitual residence as a result of such events, is unable or, owing to such fear, is unwilling to return to it. A person who qualifies for the protection of the United Nations provided by the High Commissioner for Refugees (UNHCR), in accordance with UNHCR's Statutes and, notably, subsequent General Assembly resolutions clarifying the scope of UNHCR's competency, regardless of whether or not he or she is in a country that is a party to the 1951 Convention or the 1967 Protocol – or a relevant regional refugee instrument – or whether or not he or she has been recognized by his or her host country as a refugee under either of these instruments.[1]

Relocation: In the context of humanitarian emergencies, relocations are to be considered as internal humanitarian evacuations and are understood as large-scale movements of civilians, who face an immediate threat to life in a conflict setting, to locations within the same country where they can be more effectively protected.[1]

Remittances: Personal monetary transfers, cross border or within the same country, made by migrants to individuals or communities with whom the migrant has links. A distinction should be made between formal remittances as captured in the above definition and informal remittances. Informal remittances are remittances in cash or in kind that are transferred outside the formal financial system. Statistics on remittances normally only capture formal remittance flows. Increasingly, the terms "social remittances" or "social capital transfer" are used in the context of transfers of non-monetary value as a result of migration, such as transfer of knowledge, know-how, networking and skills.[1]

Reparation: Set of measures arising from judicial or administrative decisions, designed and implemented to redress the violation of a right.[1]

Resettlement: As a legal term, the transfer of refugees from the country in which they have sought protection to another State that has agreed to admit them – as refugees – with permanent residence status. In more informal terms, often synonymous with "relocation" (see above).

Resilience: In the context of humanitarian, development, peacebuilding and security policies and operations, the ability of individuals, households, communities, cities, institutions, systems and societies to prevent, resist, absorb, adapt, respond and recover positively, efficiently and effectively when faced with a wide range of risks, while maintaining an acceptable level of functioning and without compromising long-term prospects for sustainable development, peace and security, human rights and well-being for all. When considering both society and environment, resilience is the ability of a system, community or society exposed to gradual changes or sudden hazards to resist, absorb, accommodate, adapt to, transform and recover from the effects of the change or the hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions.[1]

Resources: Parts of the natural world, including land, water, air and materials, that can be used in economic activities to produce goods and services. Material resources are biomass (like crops for food, energy and bio-based materials, as well as wood for energy and industrial uses), fossil fuels (in particular coal, gas and oil for energy), metals (such as iron, aluminium and copper used in construction and electronics manufacturing) and non-metallic minerals (used for construction, notably sand, gravel and limestone).[2]

Resource governance/management: Sustainable resource management means both (a) ensuring that consumption does not exceed levels of sustainable supply and (b) ensuring that the Earth's systems are able to perform their natural functions (i.e. preventing disruptions like in the case of greenhouse gases (GHGs) affecting the ability of the atmosphere to regulate the Earth's temperature). It requires monitoring and management at various scales. The aim of sustainable resource management is to ensure the long-term material basis of societies in a way that neither resource extraction and use nor the deposition of waste and emissions will surpass the thresholds of a safe operating space.[2]

Safe, orderly and regular migration: Movement of persons in keeping with both the laws and regulations governing exit from, entry and return to and stay in States, and with States' international law obligations, in a manner in which the human dignity and well-being of migrants are upheld, their rights are respected, protected and fulfilled, and the risks associated with the movement of people are acknowledged and mitigated.[1]

Short-term migrant: A person who changes his or her place of usual residence for more than three months but less than a year (12 months). Except in cases where the movement to that country is for purposes of recreation, holiday, visits to friends or relatives, business or medical treatment.[1]

Socio-environmental systems: The National Socio-Environmental Synthesis Center (SESYNC) describes

a socio-environmental system as referring to "a group of humans, social elements, and processes that interact with each other and nature. Sometimes called socio-ecological systems, they are more formally defined as complex systems of tightly linked social and environmental subsystems or component parts. Each subsystem has many components that interact not only with one another but also with other elements across parts of the system and across levels of organization socially, ecologically, temporally, and spatially".

Stock/base: A stock or base is the quantity (e.g. mass) of a chosen material that exists within a given system boundary at a specific time. In terms of measurement units, stock is a level variable (i.e. it is measured in kilogrammes) as opposed to material flows (which are rate variables).[2]

Systems approach: An approach to management that (1) considers the total material throughput of the economy from resource extraction and harvest to final disposal, and their environmental impacts, (2) relates these flows to activities in production and consumption across spatial scale, time, nexus and boundary dimensions, and (3) searches for leverage points for multi-beneficial changes (technological, social or organizational), all encouraged by policies to achieve sustainable production/consumption and multi-scale sustainable resource management.[2]

Temporary migration: Migration for a specific motivation and purpose with the intention to return to the country of origin or habitual residence after a limited period of time or to undertake an onward movement.[1]

Tipping point: In a social and environmental context, a tipping point refers to a time or state where further changes, however minor, are likely to result in (relatively) much more significant, and potentially, irreversible negative outcomes.

Trapped populations: Populations that do not migrate, yet are situated in areas under threat, [...] at risk of becoming "trapped" or having to stay behind, where they will be more vulnerable to environmental shocks and impoverishment.[1]

Vulnerability: Within a migration context, vulnerability is the limited capacity to avoid, resist, cope with, or recover from harm. This limited capacity is the result of the unique interaction of individual, household, community and structural characteristics and conditions.1 Similarly, Adger (2006) defines vulnerability in the context of migration and environmental conditions as "the state of susceptibility to harm from exposure to stresses associated with environmental and social change and from the absence of capacity to adapt".

References

1. IOM (2019) Glossary on Migration. https://publications.iom.int/system/files/pdf/iml_34_glossary.pdf

2. IRP (2022) Glossary. https://www.resourcepanel.org/glossary

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PREFACE

Availability, access to and use of natural resources are key intervening variables for understanding, analysing and managing local or global relationships between climatic or environmental changes and population distribution and movements. While much debate and research has focused on the effect of climate change on migration worldwide, surprisingly little attention has been paid to the role and governance of natural resources in this relationship.

Since 2007 the International Resource Panel has provided independent, authoritative and policy-relevant scientific assessments on the status, trends and future state of natural resources. This report opens a discussion about the natural resource nexus with human mobility, using an integrative approach that considers multiple causalities and networks of interaction. The research in this report, which involved qualitative and quantitative methods, shows that the relationship between natural resources and migration calls for a consideration of human-environment interactions as a complex adaptive system.

This report finds that natural resources have a significant impact on human mobility, but that the relationships are not linear. They can both mitigate or exacerbate involuntary migration, depending on specific ecological and economic constraints. Natural resources act as an intervening pathway between environmental change, climate change and human mobility. Hydropower projects represent the most direct connection between natural resource development and involuntary migration, and their expansion as a cleaner source of power generation in the years to come will need to be carefully managed. As an example of such complexity, mineral rushes can accentuate localized migration but may reduce voluntary international migration.

The impact of refugee camps on resource use and degradation was studied using geospatial analysis. The negative impact was found to be minimal and, in some cases, areas were restored for the purposes of food production. As the impact of sea-level rises on migration has been examined in previous work by development agencies, this report focused instead on other environmental variables that have a direct resource linkage (while also considering policy interventions such as "managed retreat" from coastal areas). Based on scientific findings, the report advocates for a complex adaptive systems approach to policy interventions. These should consider sociopsychological, financial and demographic factors that mediate natural resource-(im)mobility pathways. The report further identifies efficient policies within the resource-mobility nexus such as: land ownership and tenure rights and migrant remittances (including "green remittance bonds") as a way to manage the resource-mobility nexus more effectively for better ecological and economic outcomes. The report calls on policymakers to recognize the need for monitoring resource security areas with vulnerable human populations.

The lead authors and their teams have succeeded in drawing together an evidence base that proves the need for managing the intersection between resources and mobility.

The report recognizes that the recent war in Ukraine, and earlier wars and crises in the past decade, demonstrate the lack of a global governance system for migration. Although the Global Compact for Safe Orderly and Regular Migration could serve as a policymaking framework for managing the intersection between resources and mobility, it needs further development if it is to offer more formal mechanisms for international engagement that take account of differences in natural and cultural environments.

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EXECUTIVE SUMMARY AND OVERALL MESSAGES

There is increasing speculation over how current climate changes worldwide might affect the distribution and movement of people internationally. Within the relevant debates and research, surprisingly little attention has been paid to the role of natural resources, their connections to living conditions and shifts in population movements that might be observed in response. This is despite the significant direct and indirect influence of natural resources on people's needs, abilities and motivations to migrate – either temporarily or permanently.

This document uses the International Resource Panel definition that adopts a broad view of resources (including land, water, air and materials) as "parts of the natural world that can be used in economic activities to produce goods and services. Material resources are biomass (like crops for food, energy and bio- based materials, as well as wood for energy and industrial uses), fossil fuels (in particular coal, gas and oil for energy), metals (such as iron, aluminium and copper used in construction and electronics manufacturing) and non-metallic minerals (used for construction, notably sand, gravel and limestone)".[1] Similarly, human mobility is an umbrella term used to refer to a range of migratory behaviours that vary in time, space and agency. Human mobility in this report includes a continuum of voluntary migration to involuntary migration (or displacement), circular and seasonal movements, international, internal and micro forms of mobility such as commuting practices (see Figure 1). Moves may be individual initiatives or government organized (such as planned relocation initiatives).

This executive summary distils the key messages from a nuanced analysis of a topic that is inherently discursive. There is no unified account of the migration-resource nexus but rather a multifaceted set of scenarios and causal linkages in a complex adaptive system. Quantitative and geospatial data have been provided, as well as ethnographic narratives to highlight some of these key areas where policymakers and analysts can draw lessons. Structural inequality, in terms of income and natural resource endowments, is a key driver of human mobility. In this regard, inclusive wealth generation could be a way of mitigating involuntary migration. However, concepts of "mobility justice" and the right to migrate based on merit-based policies from governments must also be respected by policymakers. There is currently no global governance system for migration, while emerging norms such as the Global Compact for Migration need to be further developed to offer more formal mechanisms for international engagement. There are vast differences in how migration is managed by States, particularly in times of conflict. This has been seen in the recent war in Ukraine and earlier wars and crises within the past decade in Afghanistan, Syria, Yemen, Iraq and the Bolivarian Republic of Venezuela. This assessment is keen to recognize that the resource nexus is highly specific to each natural and cultural environment.

The assessment covers the conceptual and empirical connections between resources and human mobility (Chapter 2), the baseline data underlying their interrelationships (Chapters 3 and 4), nuanced ethnographic understandings (Chapter 5) and emerging policy prescriptions (Chapter 6). Research into environmental parameters influencing the spectrum of population movements has traditionally examined how actual or predicted climatic changes (such as temperature and precipitation regimes or anomalies) might correlate with the movement of people. However, attempting to quantify, monitor, understand and manage resource stocks, flows and degradation could provide the missing link for more indirect correlations between climate change and displacement or migration.

Human mobility can take many forms, both broadly and in the context of changes in natural resources (Chapter 2). Displacement by large hydropower projects is one of the most direct and predictable linkages between forced displacement and resources, which inherently impacts populations' access to the land with which they are associated. They can be displaced by sociopolitical turmoil, such that the movement of people away from such impacted areas

1 https://www.resourcepanel.org/glossary.

can create new pressure points for resources in inwards mobility locations. Mineral resources can lead to temporary international/intranational movement, which can have a major impact on environmental systems but can also serve to mitigate the need for international mobility (see Chapters 3 and 4). People might move when their livelihoods are threatened by degrading land resources. However, they might also remain trapped in a degrading environment through a lack of financial, social or human capital to move (see Chapters 4 and 5).

Multiple social, economic and political factors mediate the relationships between degrading natural resources and migration, including factors such as land tenure and dowry payments (Chapter 5). However, the economic remittances migrants send back to their households and communities of origin can potentially act as a source of funding and knowledge for sustainable natural resource management (Chapter 6). As such, human mobility can and should be acknowledged as an important adaptation strategy under conditions of pervasive global and more localized environmental change and resource pressures. "Trapped" populations, characterized by involuntary immobility, can therefore generate natural resource impacts in addition to humanitarian concerns.

The resource nexus with human mobility and migration is best understood as a complex adaptive system rather than a series of causal linear mechanisms. The systems thinking advocated within this report (and by other research) increases the inclusion of the sociopsychological, financial, demographic, environmental and political dimensions that mediate the natural resource-(im)mobility pathways. Complex adaptive systems are typically characterized as uncertain, non-linear and co-evolving with emergent properties. In terms of human (im) mobility, this may mean sudden migration flows or immobile populations that are unable or unwilling to move. In terms of natural resources, this may mean the collapse of ecosystem services or the sustainable management of resources. Natural resource shocks and stresses are both examples of the impact that climate change can have on migration. For example, minor changes in natural resource use and availability can cause major changes in the number of people moving, while major changes in these resources can see populations trapped. Adopting a systems understanding of the linkages between natural resources and mobility can help policymakers identify entry points for national and local policy to ensure the well-being of those affected by natural resource stress and shocks and protect the natural resources on which they depend.

Chapter 2 - Key messages: Natural resources, displacement and mobility

1. Human mobility is driven by the complex interaction of environmental degradation, land-use change and resource depletion alongside other drivers including social, economic, political and demographic influences. The availability of, access to and management of resources contribute to the causes and drivers of human mobility, but most of the research acknowledges that the causal link is complex and ambiguous.

2. Most experts expect that "environmentally induced migration" will grow in the coming decades. Such migration is defined by the International Organization for Migration (IOM) as "persons or groups of persons who, predominantly for reasons of sudden or progressive changes in the environment that adversely affect their lives or living conditions, are obliged to leave their habitual homes, or choose to do so, either temporarily or permanently, and who move within their country or abroad".

3. Involuntary immobility occurs when vulnerability exceeds the capacity to move. Human mobility is a continuum from more voluntary forms of migration to forced displacement.

4. Mobility decisions result from a combination of factors, where natural resource dynamics interact with other political, social, demographic, security and economic issues. There may be feedback processes where human mobility affects resources and environmental change.

5. Resources, and current systems of resource governance, access and benefit sharing, underpin the dynamics of so-called "environmentally induced migration", and also "economic migration".

6. Resource management systems might hold the key to a better understanding of the relationships between the environment and human mobility and help to maximize the benefits of natural resources. Additionally, the role of governments in influencing people's needs, aspirations and abilities to migrate has been downplayed. Appropriate policy responses require these relationships to be better understood.

Chapter 3 - Key messages: Mapping displacement, migration and natural resource use

1. Internationally, spatial patterns of natural resource demand are determined by international and internal migrant flows and by supply chain linkages between resource extraction and end use sites. Although international migrant flows show some association with natural resource availability, insights and trajectories are highly case specific

2. Globally, the top 200 recent hydropower developments (2000-2018) are estimated to have displaced between 900,000 and 2 million people while also causing substantial land-use change since the start of the century. While new hydropower infrastructure is typically developed in remote areas, many current and expected projects will probably displace large numbers of people globally.

3. Refugee camp establishment is associated with rapid land-use changes. In contrast, activities by camp inhabitants (fuelwood gathering and subsistence farming) often constitute productive land use around and within the camp (where access and use are permitted). It is crucial for research and effective policy formulation to consider the impacts of socioeconomic vulnerability, freedom of movement and host community relations on refugee camps' natural resource access and dependence. Refugees often have little agency in selecting the camp's location or in immediately accessing surrounding natural resources.

4. Resource rushes are often accompanied by relatively discrete inwards mobility phenomena and abrupt land-use changes for settlement establishment and mineral extraction. Under current resource extraction pathways, such rushes are characterized by trade-offs between improved socioeconomic outcomes for migrants (and local communities more generally) and widespread environmental externalities.

Chapter 4 - Key messages: Climate, natural resources and mobility: statistical analysis

1. Using episodes of drought as an indicator of land resource stress, internal mobility was found to increase with natural resource stress throughout Africa.

2. For the higher income African countries, drought is associated with increased international mobility.

3. This contrasts with the finding that, for poorer countries, drought is associated with decreased international mobility - indicating liquidity constraints on this type of mobility.

4. The study finds that the magnitude of the drought effect is smaller at the international level than the subnational, such that droughts seem to be more closely linked to subnational mobility as opposed to international mobility decisions.

5. This report provides evidence for the notion that natural resource shocks, in this case caused by droughts, are associated with poverty traps, where the shock prevents people from moving to potentially improve their livelihoods. On the other hand, the presence of alternative sources of income was found to greatly improve drought resilience at the national and subnational levels. By combining international and subnational analyses, previous findings on drought resilience (Laurent-Luchetti 2019; Cattaneo and Peri 2016) were extended to shed light on the importance of local income sources other than the drought-sensitive agricultural sector. Furthermore, droughts seem to be more closely related with subnational than international migration because the latter tends to be more expensive. This is relevant because droughts negatively affect agricultural productivity and cause poverty traps at the national level.

Chapter 5 - Key messages: Systems analysis of resources and (im)mobility

1. While it is possible to assess which conditions give rise to resource strains, the ways in which they impact people's (im)mobility plans are part of a wider complex system. Systems maps highlight potential sources of policy intervention points to reduce the link between natural resource shocks and forced or undesirable (im)mobility. Incorporating systems mapping into policy intervention planning could help highlight trigger points and areas in need of support.

2. Results indicate that eroded health and well-being often damaged people's capacities to respond, cope and plan around natural resource strains. Health and well-being are often contributing factors in negative migration experiences, longer-term displacement and undesired immobility.

3. Evidence supports the idea that targeted protection measures around debt and the provision of alternative financial support can break destructive poverty cycles and avert forced displacement or involuntary immobility for those affected by natural resource degradation.

4. Sustainable natural resource management can ensure more secure livelihoods and ecosystem services, as well as helping to minimize forced displacement and involuntary immobility. For example, sustainable resource use can be supported by financial mechanisms to support the use of remittances for sustainable resource management (such as private-public match funding) and job creation.

5. More policy research must be tailored around a systems approach. Systems thinking increases the inclusion of the sociopsychological, financial, demographic, environmental and political dimensions that mediate the natural resource-(im)mobility pathways. Incorporating systems mapping into policy intervention planning could help identify trigger points and areas in need of support. Systems maps highlight potential policy intervention points to reduce the link between natural resource shocks and forced or undesirable (im)mobility. Systems diagrams can indicate areas in need of more focus through absent factors. One example would be the ways that (im)mobility may support sustainable resource management in the future. The complex characteristics of a systems network serve as a reminder that the future is not linear, simplistic or predictable.

Chapter 6 - Key messages: Resource-human mobility nexus: policy options

1. Resources and mobility have typically been seen as separate rather than interrelated policymaking issues. As a result, existing policies that concern both are vague and underdeveloped.

2. The suggestion is that policies within the resource-mobility nexus should be aligned along two fundamental axes: The first aim should be to enhance adaptation potential, sustainability of resources and socioeconomic and environmental resilience so that resource pressures do not force people to move. When this cannot be ensured, the second aim should be to promote the safe and well-managed movement of people to other locations.

3. Options for "staying" in place include strengthening the vitality and sustainability of the resource base to improve socioeconomic resilience, ensuring local communities have rights of ownership and tenure over resources, fostering livelihoods that are less reliant upon resources and facilitating external inputs like remittances and development assistance. This can alleviate pressure on resource stocks.

4. Options for "moving" include effectively managing resources that may pull people towards them, as well as movement of people away from areas of resource limitations in the form of resettlement from one country to another, as well as the managed retreat of populations away from vulnerable areas within and across national borders.

5. Conceptually, "mobility justice" and "climate reparations" are recommended as guiding principles in future approaches to the resources-mobility nexus. Embodying many of these principles, the Global Compact for Migration could serve as a policymaking framework to manage the intersection between resources and mobility.

6. A systems approach and related adaptive planning framework, with continuous monitoring of a range of data and thresholds, should be adopted for mobility related to resources. Policymakers need to be flexible in their decision-making approaches and be informed by a systems planning frameworks underpinned by empirical evidence. Such data could be used to generate scenarios to be considered through an assessment process involving multiple criteria and a consultative process with community members, with a view to formulating contingency plans for voluntary and involuntary mobility.

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INTRODUCTION AND CONTEXT

1.1 The resource-mobility nexus

The idea that the movement of people might be linked to natural resources is by no means a new concept. For most of the 200,000 years of human existence, mobility was strongly linked to resource access, with moves often being seasonal and exploratory for hunters and gatherers. It was only with the advent of agricultural practices around 11,000 years ago that more stable and permanent settlements began to emerge as human civilizations developed (Steffen et al. 2011). However, the impetus behind individual or group decisions to move has always been multifaceted. The basic premise behind this assessment is therefore that modern human mobility is the result of complex social and ecological interactions on different levels involving many feedback loops. Similarly, there are many types of mobility involving a range of time, space, scales and motivations. Different authors have classified movements as temporary, seasonal, forced, planned, economic, refugee and displaced, to name just a few categories. In line with the above, this assessment aims to consider the full spectrum of human mobility.

In the modern world, resource factors have relatively clear influences on limiting or enabling human mobility. Similarly, demographic changes can be seen to have positive and negative impacts on resource consumption and management (see Box 1). Mobility of populations for resource access might even be a matter of survival in some contexts. In other cases, populations can be trapped (willing but unable to move) despite declining resource availability due to social, political or economic reasons (Ayeb-Karlsson et al. 2020). In such cases, the impact of not moving can be unhelpful for ecological systems and the people in question. This assessment identifies some of the dominant resource factors and contexts that emerge from an analysis of migrants' mobility choices and decisions. This has involved analysing the impact of resources on mobility and vice versa.[2]

1.2 Environmental change, resources and mobility

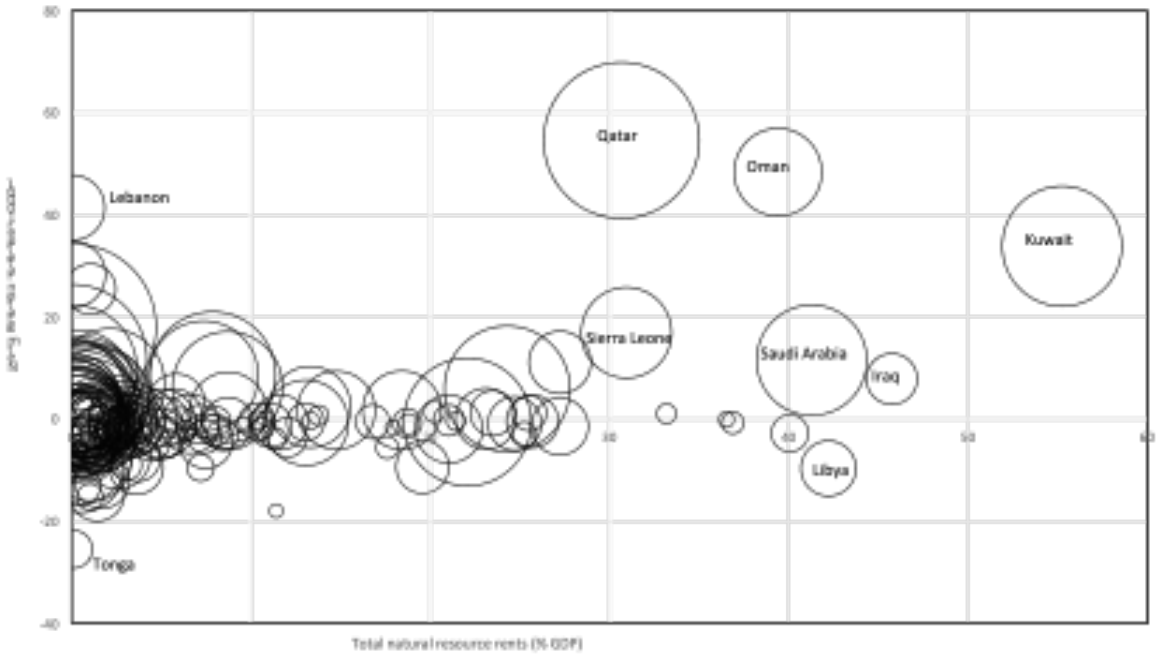
Connections between resources (as defined by the IRP) and mobility are part of wider debates about how environmental change relates to human movement. Regional or global environmental changes affecting ecological ranges, land surface cover and condition, levels of aridity or desertification and predictability and extremity of weather patterns are often claimed to have an impact on human mobility and habitation (Intergovernmental Panel on Climate Change [IPCC 2019]). Such environmental changes have accelerated over the past two centuries due to overexploitation and unsustainable use of resources (United Nations Environment Programme [UNEP] 2017; Hertwich et al. 2019). Global population increases and expanding human settlements, coupled with unequal and escalating intensity of resource consumption, have resulted in interconnected and pervasive trends of environmental degradation (UNEP 2019), biodiversity loss and overexploitation and diminishment of ecosystem services (Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services [IPBES] 2019; World Wide Fund for Nature [WWF] 2020). While examples of unsustainable resource use are a long-standing feature of human history (Douglas et al. 2015; Micklin 2007), the apparent scale, speed and potential irreversibility of recent resource degradation and exploitation, combined with the significant number of people affected, make the current situation unique and worrying. In fact, the precariousness of environmental viability is probably more advanced than previously thought (Bradshaw 2020).

These global trends are putting pressure on finite resource stocks and the ongoing viability of renewables. Potential causal (rather than proximate) connecting forces between movement and climatic/environment changes refer to the available resource base. For example, prevailing conditions or anomalies in temperature and rainfall do not directly account for movement of people. Rather, it is the impact that temperature and rainfall have on resources such as agricultural land, water availability and biomass for fuel and food. In a similar vein, it is the results of human overexploitation of materials that have altered prevailing climatic conditions in the first place.

2 According to the United Nations Environment Programme (UNEP) and IRP: resources — including land, water, air and materials — are seen as parts of the natural world that can be used in economic activities to produce goods and services. Material resources are biomass (like crops for food, energy and bio- based materials, as well as wood for energy and industrial uses), fossil fuels (in particular coal, gas and oil for energy), metals (such as iron, aluminium and copper used in construction and electronics manufacturing) and non-metallic minerals (used for construction, notably sand, gravel and limestone). (Glossary | Resource Panel).

Box 1. Annual net migration rate per 1,000 inhabitants from 2010-2015 (source: Population Division of the UN) versus total natural resource rents (as % of GDP) natural resources (source: World Bank) for different countries. The size of the circles are a function of GDP per capita.

At the macro scale, there is a small positive relationship between a country's natural resources and its net migration. According to this relationship, countries with more natural resources tend to have more incoming migrants than outgoing migrants. In contrast, countries with fewer natural resources have more outgoing migrants than incoming migrants. However, at virtually all levels of natural resource rents there are examples of countries with both positive and negative net migration (with the former meaning more incoming than outgoing migrants, and the latter referring to more outgoing than incoming migrants).



It is therefore surprising that the existing literature has not focused more on resource levels, and has instead concentrated on wider environmental (and meteorological) conditions and disaster events. There are good reasons for this, not only in terms of the endogenous nature of using natural resources as an explanatory factor of migration while also being affected by migration (which can limit quantitative studies), but also because global climate change is widely recognized as a key driver of natural resource degradation and where activities that affect natural resources drive climate change. This report is based on the assumption that natural resource degradation can be a function of indirect human activity through anthropogenic climate change, natural climate variability and more directly from a variety of non-climatic human based activities. Providing inputs on understanding how resources relate to environmental change and migration contributes to a more nuanced understanding of migration futures and adds to knowledge of sustainable resource use in an increasingly mobile world.

1.3 The spectrum of mobility

These various typologies of human mobility are recognized and debated in the literature and in annual reports by international organizations (McAuliffe et al. 2019). Figure 1 shows some of the categories and dimensions of human mobility covered in this assessment. Figure 1 shows the temporal range (short to long term) and levels of coercion or choice (from voluntary to forced) of migration. From a policymaking perspective, level of preparedness is also included, and ranges from pre-empting movement in a proactive manner to responding in a reactive fashion. The time frame of migration can be both negative and positive dependent upon context. There is an understandable wish to avoid forced migration from a humanitarian standpoint. In addition, policymakers should aim to have well-developed plans for managing movement at each end of the continuum shown in Figure 1: that is, before it occurs as well as reacting to unforeseen events.

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Despite being initially coined in the 1980s (El-Hinnawi 1985; Jacobson 1988), the idea of "environmental migrants" (or even environmental refugees: Ionesco 2019) as a result of natural disasters (rapid change) and/or more gradual environmental perturbations (slow-onset change) is now becoming increasingly familiar in policymaking circles (Foresight 2011; Ionesco et al. 2017) and the popular imagination. However, it also tends to subvert the growing body of empirical studies that point to the multi-causal nature of mobility and what is often an indirect link between environmental change and mobility decision-making.

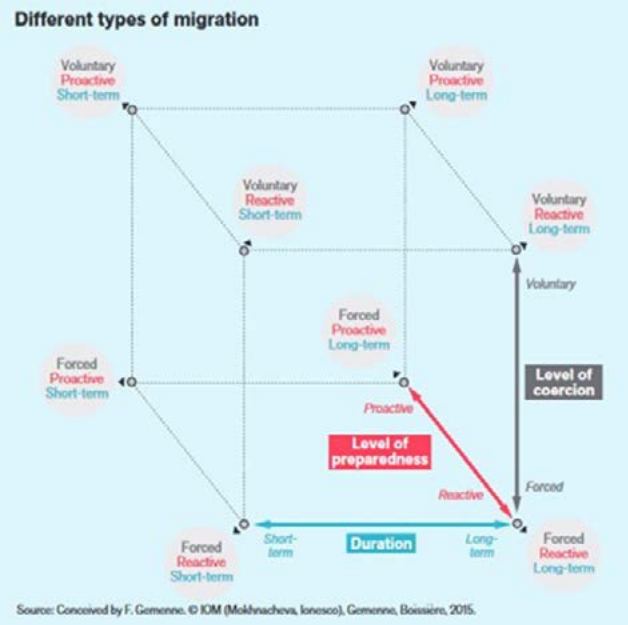

Figure 1. Different types of migration

1.4 IRP interest in resource and migration

Resource availability, access, use and management provide potentially pivotal factors in mediating the linkage between environmental change and mobility. One of the main drivers of movement highlighted by past research is the erosion of livelihoods in locations of origin and the pull of better and more secure livelihood opportunities in destination locations. In origin locations, the reasons for a decline in livelihoods are sometimes linked to natural resource degradation, such as loss of land by riverbank erosion or a lack of investment in soil fertility (Ahmed et al. 2019; Ayeb-Karlsson et al. 2016; Black et al. 2011; Deshingkar 2012). Sometimes the process is more anthropological: manmade infrastructure that impacts the environment, such as dams, might also led to a decline in livelihoods and impetus to move.

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Mobility as a topic emerged as a priority for the IRP for two reasons. First, human-induced slow-onset environmental change and sudden disaster events have real implications for resources management and migration. Second, the nexus between the two has often been neglected - conceptually and empirically - in academia and policymaking. Furthermore, while a gradual or rapid deterioration of environmental conditions is often depicted as a driver that leads to social instability and forced displacement, migration can also be a means of developing the capacity for sustainable resource management (for example, through the use of social and financial remittances [Banerjee et al. 2017]). Indeed, movement is already considered a form of adaptation to the impacts of climate change (Foresight 2011; Ionesco et al. 2017; Renaud et al. 2011; Salerno et al. 2017).

The IRP aims to add to the current understanding of the interconnections between mobility and resources as one of its key future research priority areas.

Exploring 'Sustainable Management links to Migration and Conflict' is one of the Panel's four high-impact priority areas (HIPAs) within its Work Programme. Within this HIPA, the intention is to collaboratively research the interlinkages and pathways between natural resource availability, use and management, while also contributing to broader debates on environmentally related movement and specific questions of resource management.

A number of policy questions relevant to the IRP's agenda are also relevant to the resource-mobility nexus. For example, one question looks at the policy contexts and conditions where better management of (local, regional and global) natural resources could play a role in avoiding forced displacement. Given that migration is likely to be an ongoing phenomenon for a variety of reasons, another question is how to prevent further unsustainable resource use in likely locations of inwards movement. The important starting point is to not demonize migrants who are universally recognized as adding to the social, economic and cultural fabric of societies. Instead, and in line with one of the IRP's main driving notions, the long-term impetus of this research is to contribute to the decoupling of poor resource management from inwards and outwards mobility.

1.5 Resource-mobility nexus as a complex system

Context is important at the local and regional levels, while impact and the scale of change in resource dynamics depend on interrelated socioenvironmental systems. Resulting movement or immobility are determined by a complex combination of environmental, social, political and economic forces (see Rahman and Hickey 2020; Cardona et al. 2012). This, in turn, strongly influences the ability of different populations to weather, adapt or 'transform' in response to the degradation and reduced availability of various resources (United Nations 2016). The links between natural resources and human mobility tend to be complex, running in many directions with multiple pathways, intermediate stages, engagement points and potential outcomes. The confluence between the two can be thought of as sharing the properties of a complex evolving socioecological system (Giampietro 2019; Preiser et al. 2018). This system operates at different temporal, spatial and social scales, has nested hierarchies, multi-directional feed backs, multilevel interactions, inevitable uncertainty and some of the features of emergent non-equilibrium systems (Berkes et al. 2002; Gunderson and Holling 2002; Kniveton et al. 2012; Mayumi and Giampietro 2006; Rammel et al. 2007).

1.6 Structure of the report

The main report begins with a critical literature review on resources and migration in Chapter 2. Building upon the conceptual links between resources and migration, Chapters 3 and 4 examine current capability to map spatial relationships between migration and resources at the international, regional and local levels and any preliminary trends. The report then shifts, in Chapter 5, to attempt to identify and connect examples of the many direct and indirect links between resource use and migration, before compiling them into a socioecological system through the use of case study examples and relevant ethnographic data. Key issues arising from the analysis are then used as a basis for highlighting and suggesting policymaking interventions in Chapter 6.

The report uses a hybrid, interdisciplinary approach based on a range of methods and varied data sources, with a view to producing a significant and globally relevant assessment of the relationship between resource management and migration patterns.

The report uses a hybrid, interdisciplinary approach based on a range of methods and varied data sources, with a view to producing a significant and globally relevant assessment of the relationship between resource management and migration patterns. It asks questions about how resource use fits into prevailing narratives and trends observed around climate and migration, such as climate related disaster displacement and trapped populations. The aim is to generate debate and further analysis about how to address significant contemporary and near-future concerns on the distribution, use and degradation of resources and their relationship to migration patterns. The document can also open up discussions about potential entry points for policy improvement and development in terms of environmentally influenced mobility covered in the report.

2

NATURAL RESOURCES, DISPLACEMENT AND MIGRATION

Oli Brown, Riyanti Djalante and Caroline Zickgraf

Key messages

1. Human mobility is driven by the complex interaction of environmental degradation, land-use change and resource depletion. The availability of, access to, and management of resources contribute to the causes and drivers of human mobility, but the majority of the research acknowledges that the causal link is complex and ambiguous.

2. The majority of experts expect that environmentally induced migration will grow in the coming decades, as a result of climate change and global demographic patterns.

3. Human mobility is a continuum from more voluntary forms of migration to forced displacement. Immobility, though sometimes voluntary, occurs when vulnerability exceeds the capacity to move.

4. Resources, and the systems of resource governance, access and benefit sharing in use, underpin many of the dynamics of what is often labelled "environmentally induced migration", but also what has been called "economic migration".

5. Resource management systems might hold the key to a better understanding of the relationships between the environment and human mobility and help to maximize the benefits of natural resources. Additionally, the role of governments in affecting people's needs, aspirations and abilities to migrate has been downplayed. Appropriate policy responses require these relationships to be better understood.

2.1 Introduction

Current international policies around global human mobility tend to be based on a binary understanding of why people move. They are either forced to move as a result of conflict or political persecution - and seen as refugees- or enticed by the promise of better living conditions elsewhere - and labelled as migrants (Ionesco, Mokhnacheva and Gemenne 2017). The reality, of course, is more nuanced and complicated. Human mobility has existed throughout history, with people moving for, or being displaced by, a diverse range of interconnected environmental, economic, political, social, humanitarian and cultural factors (Black et al. 2011; Van Praag and Timmerman 2019).

The potential implications of resource access and availability and environmental degradation on migration and displacement have been studied for decades (see Döös 1997, for instance). This literature has expanded dramatically in the last 20 years, particularly as research has begun to uncover the potential ramifications of climate change on population distribution (McLeman and Gemenne 2018). As highlighted in the following review of the literature, a specific focus on resource types, stocks and flows has received much less attention.

Researchers have developed narratives to explain the causes, forms and impacts of migration in order to propose or justify various policy interventions (Vlassopoulos 2013). There have been various interdisciplinary attempts to reassess the framework of migration research and bring in new perspectives from social and cultural geography (Felgentreff and Pott 2016). Piguet (2010) identifies six distinct families of research methods aimed at understanding environmentally induced migration: ecological inference based on area characteristics, individual sample surveys, time series analysis, multilevel analysis, agent-based modelling (ABM) and qualitative/ethnographic studies. The sector is now even developing meta-studies of the existing literature and identifying gaps in empirical coverage (Cattaneo et al. 2019; Obokata et al. 2014; Upadhyay et al. 2015).

The purpose of this chapter is to summarize current knowledge on the links between natural resources and human mobility, as discussed in the existing literature. To do so, this chapter weaves together some of the key points from more than 140 books, articles and chapters (mostly from peer-reviewed literature since 2000). The aim is to highlight key points of agreement in the literature and identify any areas of ongoing

debate. This provides a context and foundation for later chapters on modelling, projections and policy impacts and responses.

This chapter is divided into three main sections. The first looks at the availability of, access to and management of resources and environmental change in the causes or drivers of human mobility (in other words, why people move). The second section assesses the role of resources and environmental change in the forms of displacement and migration (or how, where and for how long people move). The third section addresses the role of resources and environmental change on the impacts of movement (namely, how this affects communities of origin and destination and the migrants or displaced people themselves).

2.2 The role of natural resources in driving human mobility

Migration and displacement are determined by a range of micro-, meso- and macro-level factors. These include access to financial and social capital, the viability of alternative livelihoods and the existence of institutional opportunities and barriers to migration (Kniveton et al. 2012). The public narrative around environmentally induced migration implies that the causal relationships are clear and consensual (Betts and Pilath 2017). However, most research acknowledges that the causal link is complex and ambiguous (ibid.). Many researchers have noted that mobility decisions result from a combination of factors, where natural resource dynamics interact with other political, social, demographic, security and economic issues (Black et al. 2011; Foresight 2011). This section therefore explores how natural resources contribute to (or drive) population movements.

2.2.1 Environmental degradation, climate change and resource depletion

Much of the associated literature since the turn of the millennium has focused on the role of localized environmental degradation, and particularly the overshadowing impacts of climate change, in depleting natural resource systems and their subsequent role in stimulating migration, forced displacement and planned relocation.

Such factors are often (imperfectly) categorized by their temporal scope (Cattaneo et al. 2019). On the one hand, there are slow-onset factors – drought, desertification, sea-level rise, land degradation and growing water insecurity – that disrupt livelihoods, especially resource-dependent ones such as farming, livestock herding and fishing. On the other hand, there are sudden-onset events – flooding, industrial accidents, storms and glacial lake outburst floods (GLOFs) – that present more imminent danger to people's lives and livelihoods, as well as harm to resource and ecosystem services (Brown 2008a). Based on how such events occur in parallel and influence one another, multi-risk scenarios have been developed to capture their convergence (Rigaud et al. 2018). There are also links with conflict in this context, and the Intergovernmental Panel on Climate Change attempted to summarize these issues conceptually in the fifth assessment report in 2014 (see Figure 2).

Some quantitative studies have drawn a direct link between the impact on resources of slow-onset environmental change and the overall size of migration flows. Feng, Krueger and Oppenheimer (2010) analysed the link between crop yields and cross-border Mexico-United States migration and estimated that a 10% drop in crop-yields would lead to an additional 2% of the population emigrating. A 2015 multilevel event study of international migration from Mexico between 1986 and 1999 found that warming temperatures and excessive precipitation significantly increased international migration (Nawrotzki et al. 2016). In the Philippines, a rise in temperature and increased typhoon activity appear to be linked to increased outmigration (principally due to reduced rice crop yields), although changes in rainfall did not appear to have a consistently significant effect on migration patterns (Bohra-Mishra et al. 2017). Cai et al. (2016) found a statistically significant relationship between temperature and international migration, but only in the most agriculturally dependent countries (given the link between rising temperatures and diminishing agricultural yields). A village-level study of the Kilimanjaro district in Tanzania noted a positive relationship between rainfall shortage and outmigration, even after controlling for other important socioeconomic variables. The study argues that food insecurity for humans and livestock is the mechanism through which rainfall variability affects human mobility (Afifi et al. 2014). In that vein, household surveys conducted in the northern Central American countries of Guatemala, El Salvador and Honduras identified a notable increase in outmigration following the onset of drought, its impact on agricultural land and subsequent food security (IOM et al. 2015).

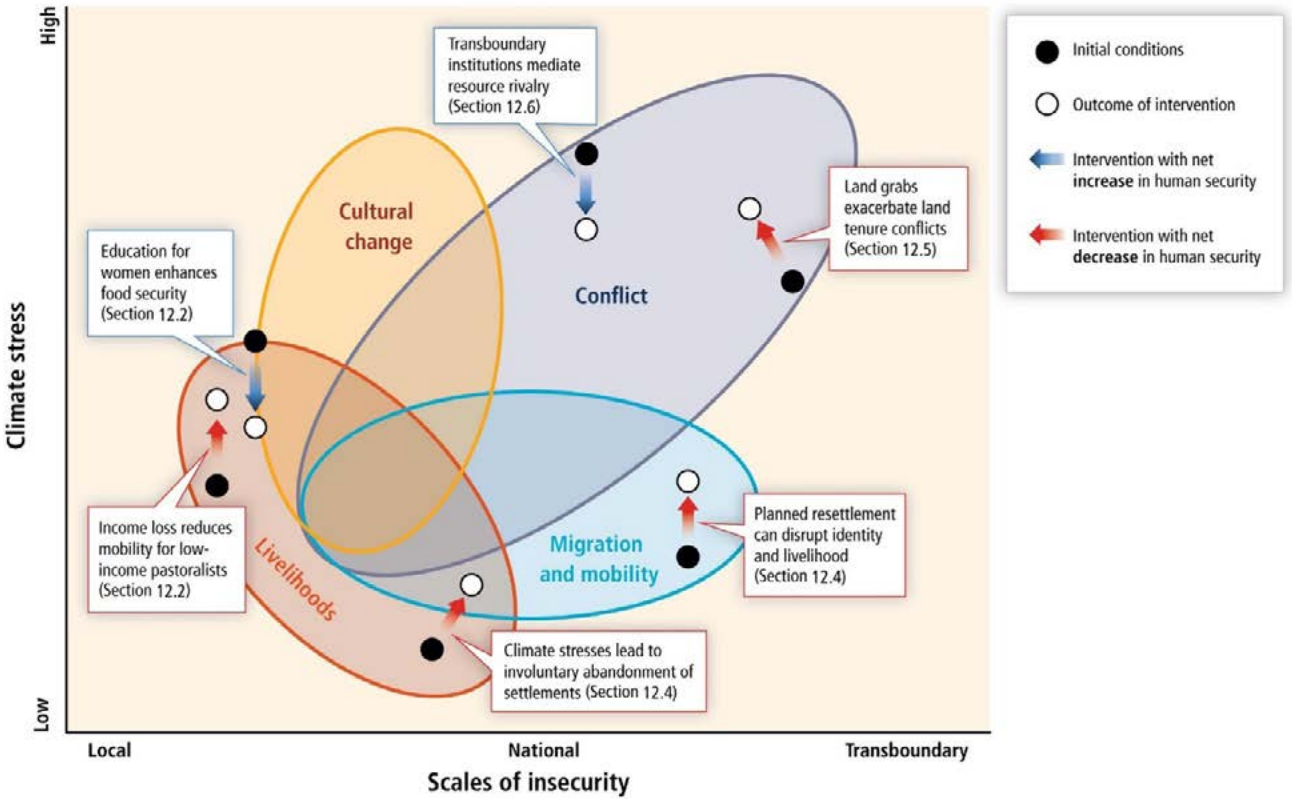

Figure 2. The conceptual space for migration and mobility as considered by the Intergovernmental Panel on Climate Change, with reference to sections in their fifth assessment report (IPCC – AR5-WG2 Report 2014)

There have also been attempts to investigate the impact on human mobility of sudden-onset events, such as floods, hurricanes and disaster-induced industrial accidents[3] (Black et al. 2013; Zhang et al. 2014). However, the links to natural resources tend to be overlooked or more implicit. In Viet Nam, regular flood events were linked to displacement, individual migration decisions and Government-initiated resettlement of households (Dun 2011). In this case, the resettlement initiatives moved people short distances in order to maintain social cohesion and access to agricultural land to decrease poverty (Zickgraf 2019). A review of select Asian countries between 2005 and 2017 noted that natural hazards such as storms and floods generally increased external migration. The study posited a direct link with natural resources, noting that "natural resource depletion increases external migration" (Abbas Khan et al. 2019).

Climate change is, of course, just one of many factors influencing mobility decisions (Kniveton et al. 2008). Resource use and management can affect mobility responses within and outside of climate contexts. Resource depletion through overuse (Bilsborrow and DeLargy 1990), or resource loss as a result of infrastructure projects, conservation measures and land grabbing have also been identified as important in stimulating migration and displacement (Salerno et al. 2014). Hamilton and colleagues (2004) cite the example of the Faroe Islands. The Islands have an affluent society that is highly dependent on fisheries, and experienced a crisis in the 1990s when their fisheries were depleted by a combination of overfishing and environmental stress. The result was unemployment, business failures and outmigration, particularly among young adults, which permanently changed the make-up of the islands' population. Meanwhile, Vigil (2018) provides an analysis into the controversial phenomenon of large-scale land acquisition (described as "green grabbing") in numerous locations by overseas investors. This is often for biofuels and forest carbon projects that, in some cases, have displaced local groups living or working on that land (see Nyantakyi-Frimpong and Bezner Kerr 2017).

3 Also known as natechs.

2.2.2 Vulnerability and mobility

Like climate change, changes in the quality, availability and access of resources can exacerbate pre-existing vulnerabilities and inequalities. Mobility linked to resources can, therefore, be seen as being part of and the result of a wider context of vulnerability (Adger 2006). A community's vulnerability determines how badly it is affected by environmental hazards (Adger 2006). Vulnerability is described as the state of susceptibility to harm from exposure to stresses associated with environmental change and from the lack of capacity to adapt to those stresses (Adger 2006). The Intergovernmental Panel on Climate Change (2014) suggests that the phenomenon of trapped populations arises when vulnerability is greater than people's ability to move (Figure 3).

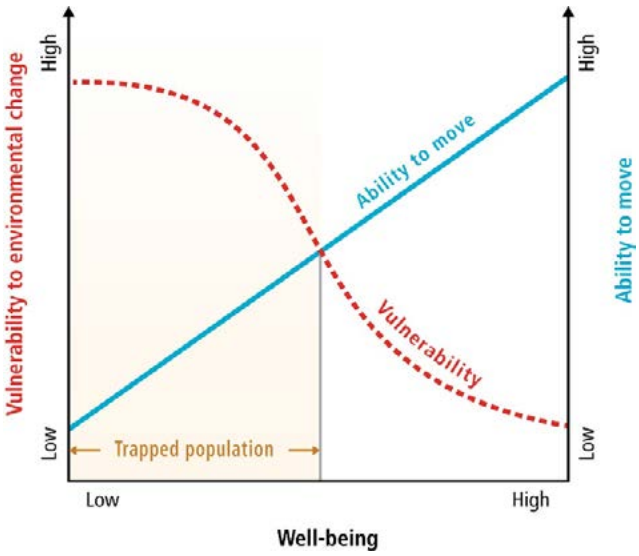

Figure 3. Relationship between well-being and vulnerability and trapped population phenomenon (IPCC 2014)

While there is no universal linear relationship between natural resources and human mobility, various studies have identified ways in which the likelihood of more voluntary forms of migration is influenced by resource dependence and vulnerability to slow-onset environmental change influence. Reliance on natural resources can increase the vulnerability of a community, household or individual, but acts in conjunction with other features. For example, Gemenne et al. (2017) argued that vulnerability and the probability of migration among individuals in West Africa are influenced by the extent of their dependence on natural resources, their socioeconomic status and their demographic characteristics. In fact, much of the literature on human mobility in response to slow-onset changes cites the importance of natural resource-dependent livelihoods in explaining populations' vulnerability (in rural and urban areas). This demonstrates the links between climate change, economic and environmental drivers of mobility.

A review of the literature makes it clear that resource-related mobility is often labelled economic migration, with its environmental roots frequently masked by other issues (Side box 1): the economic impacts of resource use and management in the community of origin, economic opportunities in destinations or the legal definitions of the migrants/ refugees themselves. Afifi (2011) identified a number of internal and cross-border mobility trends in Niger, explicitly including natural resource considerations such as those relating to water (droughts, the shrinking of Lake Chad and Niger River problems) and land (soil degradation, deforestation and sand intrusion). However, the study argued that economic factors are the mechanism through which environmental factors encourage migration, suggesting that the appropriate term for such migration should be "environmentally induced economic migration" (ibid.). Differentiating between economic and environmentally induced migration, therefore, has little value in countries whose economies are resource-dependent: in agriculture-based economies, environmentally induced migration is economic migration.

A review of the literature makes it clear that resource-related mobility is often labelled economic migration, with its environmental roots frequently masked by other issues

The literature describes a number of resource disparities that also encourage people to move in the hope of expanded or more reliable livelihood options at destination. For example, several case studies have examined the role of mineral resources (particularly artisanal and small-scale mining [ASM]) in shaping internal and cross-border migration (see Chapter 3). In the Russian Federation, a study of mining sites across 78 regions between 2004 and 2010 detailed rising net internal migration in mining areas (Sardadvar and Vakulenko 2017). Nyame et al. (2009) looked at how the different stages of mine development (growth, stagnation and closure) in Ghana led to characteristic migration patterns. They argue that these are contributing to the country becoming a transit area for prospective migrant miners, in addition to its

traditional role as a destination country for miners. Likewise, large numbers of men migrated from Lesotho to South Africa during the twentieth century to work in the commercial mines, sending remittances back to Lesotho. Since many of the large mines have closed, these men have tended to move across to the informal sector, mining abandoned mines around Johannesburg (Makhetha 2020). Meanwhile, a detailed survey of nearly a thousand male and female artisanal miners in the eastern part of the Democratic Republic of Congo found that artisanal mining sites were the destination for internal migrants, but that escape from economic hardship was a more significant factor than the perceived potential economic gains (Maclin et al. 2017). Other studies have assessed the opportunity of differing resource ownership or management systems (such as the ability to own land elsewhere, availability of services and resources offered in urban settings and so forth) as a factor in encouraging resource-related migration. The Mecúfi district of northern Mozambique has seen significant migration of people to coastal areas since the civil war, in part to access coastal and marine resources (Bryceson and Massinga 2002).

However, according to Upadhyay et al. (2015), much of the literature tends to downplay ambiguities in the terminology and overestimates what is often limited empirical evidence. As a result, the linkages are complex and not always consistent. For example, a study of soil quality in Kenya and Tanzania appeared to show that high soil quality reduced migration in Kenya but increased migration in neighbouring Uganda (Gray 2011). Gray and Wise (2016) used detailed household information to revisit the links between climate change and internal and international migration over a six-year period in five African countries: Kenya, Uganda, Nigeria, Burkina Faso and Senegal. Their results were mixed. Temperature anomalies tended to increase migration in Uganda but decreased migration in Kenya and Burkina Faso. However, they showed no consistent relationship in Senegal or Nigeria. Precipitation, meanwhile, showed a very weak and inconsistent relationship with migration across all the case study countries.

Side box 1: Migration and resources in Mexico and northern Central America

Pablo Escribano, IOM

Mexico and Central America – in particular, the northern countries of Central America (El Salvador, Guatemala and Honduras) – have been consistently identified as heavily exposed to the adverse impacts of climate change and environmental degradation (Rigaud et al. 2018). Scientific evidence has shed light on the links between Mexican and Central American migration and climate variability (Mbow et al. 2019, p. 518). The impact of climate change on migration has received considerable attention, particularly since the beginning of the so-called migrant caravans in late 2018 but also in the wake of the devastating impact of hurricanes Eta and Iota in Guatemala, Honduras and Nicaragua in November 2020.

However, researchers have qualified the linearity of the impacts of climate change and environmental degradation on migration in Mexico and Central America: it remains "difficult to parse out precisely the role that climate variability and change plays in migration, given the presence of factors including violence and insecurity, as well as long-established migration patterns from the region to the United States" (Pons 2021). It is important to consider the different pathways through which climate variability and hazards influence migration patterns, considering the heterogeneity of the region, the influence of multiple drivers of migration and the micro, meso and macro determinants at play (Government Office for Science, United Kingdom, 2011).

Understanding the role of resources as drivers of migration can improve knowledge of the climate change, environment and migration nexus in the region. It may also enhance analysis of the multi-causal nature of migration and the complex interactions between climate variability, unemployment and violence in the most exposed areas. Focusing attention on the availability of resources serves to nuance the approach to the environment-migration nexus and encourages a consideration of compounding drivers of migration, coping mechanisms and potential responses to address the adverse drivers of forced movement.

Environmental change and its impact on resource availability in Mexico and northern Central America

A recent review of available evidence on human mobility resulting from disasters and climate change in Central America identified 228 studies that address the environment-mobility nexus (IOM 2021). Within this set, non-distinct climate change and disasters appear in the largest number of documents, followed by droughts and hurricanes. Additional hazards are also identified as drivers of mobility, including floods, sea-level rise, rainfall variation and geophysical events, which points to the multi-hazard nature of vulnerabilities in the region (ibid.). Different studies have evidenced a relationship between extreme climate events and migration in Mexico and Central America, both in terms of drought and floods/storms (Kaenzig and Piguet 2014; Riosmena et al. 2018). Projections point to considerable dryness across the region, with significant internal climate variability of mid-summer drought trends (Anderson et al. 2019). These hazards have an impact on the availability of resources, notably in terms of water. Water scarcity is a key component of the resources-migration nexus in Central America and Mexico. This is due to the productive structure of Central American countries, their reliance on rain-fed agriculture, subsistence agriculture practices and the significance of climate sensitive crops (Mbow et al. 2019). Projections estimate a decrease in the productivity of crops such as beans, coffee, maize, plantain and rice (Donatti et al. 2018), which has key implications for food security, both in terms of domestic consumption and the sale of produce to pay for basic products. In Guatemala, farmers "produce some of their own food, work seasonally to pay for much of it through unskilled labour such as on coffee farms, and acquire additional food from natural sources such as forests or water bodies" (Pons 2021). Statistical analyses have shed light on positive correlations between food insecurity and migration from northern Central America (IOM et al. 2017).

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Resource availability and migration pathways

Studies have reported that maize and coffee farmers across Central America are noticing the impacts of climate change, which has had an impact on crop yields and, to some extent, changes in farming practices (Harvey et al. 2018). Employment in rural areas has also been affected by various hazards. For

example, the coffee industry provides much-needed income for farmers who work seasonally in the sector, yet coffee is highly sensitive to climate variability, with very significant yield losses and destruction of jobs across the region (United Nations Economic Commission for Latin America and the Caribbean [ECLAC 2018]). In surveys carried out by IOM in 2018 and 2019 in the region's main migration corridor, migrants rarely identified climate variability as the motivation for their journey. However, a significant share of respondents worked in the primary sector before leaving their country and most were looking for improved economic opportunities abroad (IOM 2019).

Land ownership is a critical factor and is often one of the resources that smallholders sell as a coping mechanism when yields are affected and employment becomes scarce, before individuals turn to longer term migration options.

Researchers have also shed light on other pathways bridging the gap between the limited access to resources and migration. Land ownership is a critical factor and is often one of the resources that smallholders sell as a coping mechanism when yields are affected and employment becomes scarce, before individuals turn to longer term migration options. Local populations in areas of Guatemala "identified cycles of fruitless investments and outstanding debts in agriculture as immediate drivers of decisions to migrate" (Johnson 2021). An underresearched field of analysis in Central America relates to the nexus between resource scarcity, violence and conflict and migration – where limited resources may lead to violence, struggles and ultimately migration.

Further studies suggest that, in various Central American countries, remittances received by farming households are not widely used for qualitative transformation of lands but more for an increase in row crops and pasture holdings, with potentially negative consequences for agricultural sustainability (Davis and López-Carr 2013). The effect of remittances on land use are diverse and non-linear, with a process of forest decline observed followed by local patterns of forest recovery (Taylor et al. 2016). There is a mixed picture in terms of migration from rural areas with smallholdings: "migration is at once evidence of displacement, as well as a strategy for families to prolong remaining on the land in order to produce food" (Carte et al. 2019).

The rise in migration from the northern countries of Central America is the result of multiple drivers including environmental and climate change, with a specific role played by resource availability in terms of water, land, funds and livelihoods.

2.3 The role of resources in the forms and dynamics of human (im)mobility

Human mobility is just one possible response to environmental change and opportunity (Warner 2010). Many studies have attempted to determine the causes of migration and displacement at the expense of the dynamics and outcomes of that movement in terms of who goes (and who stays), to what extent they aspire and need to move, and for how long and where they go. As highlighted by Black et al. (2013), where people go in the future and which key 'tipping points' may be associated with a significant rise (or fall) in migration to a particular destination may be more significant than the overall number of migrants globally. This section therefore focuses on how the resource picture affects the forms and dynamics of human mobility.

2.3.1 Three phenomena: migration, displacement and immobility

A growing body of literature demonstrates that not only is population movement multi-causal, but its outcomes vary greatly according to people's aspirations and capacity to migrate (de Haas 2014). Black et al. (2013b) distinguish between three broad outcomes of extreme environmental events: migration, displacement and immobility.[4] This typology is extended to the resources-mobility nexus, with the important caveat that they are relational and dynamic categories and that, in practice, it is difficult to distinguish between forced and voluntary migration (and this can have major policy implications) (Piguet et al. 2018; Ionesco et al. 2017; Laczko and Aghazarm 2009).

Warner et al. (2010) warn that simplistic assumptions about the relationship between resources and migration can lead to misleading conclusions that underplay the complex multifaceted economic, environmental, political and social processes that are the root causes of most environmentally induced migration. When people are faced with severe environmental degradation, they have one of three options: to stay and adapt to reduce the effects; to stay and accept a lower quality of life; or to leave the affected area (Warner 2010). As well as more obvious prevailing socioeconomic and political dynamics, most researchers agree that the outcome is strongly dependent on a host of mediating factors, such as individual capabilities, personal aspirations, sociopsychological factors and the opportunities available (de Haas 2010a; Carling and Schewel 2019; Ayeb-Karlsson et al. 2020).

Early literature was criticized for focusing almost exclusively on displacement, while underestimating human agency in decisions to migrate, which led to more extensive research on decision-making and perceptions of populations (Jokisch et al. 2019; Sakdapolrak et al. 2016). Koubi et al. (2016), for instance, are critical of the "rational actor" assumption implicit in many analyses of migration as a response to environmental stress (and opportunity), and instead focus on how individuals perceive various types of environmental events in different ways depending on their background and past mobility. They suggest that migrants and non-migrants perceive the extremeness of sudden-onset and slow-onset environmental events differently, and that not all will choose or be able to migrate (Foresight 2011).

This criticism has also been levelled at some of the models used to project future scenarios for environmentally induced migration (Bukari et al. 2020). Moreover, populations' perceptions of environmental change, upon which they base their migration decisions, do not necessarily align with externally observed climate data (De Longueville et al. 2020). People may also move (or be moved, in the case of relocation programmes) in anticipation of adverse resource change rather than in response to it.

In certain contexts, environmental and associated resource parameters might not actually be a determining factor for group or individual decisions to move, even if expected to. Mortreux and Barnett (2009), for example, surveyed the inhabitants of the island of Funafuti, Tuvalu, noting that most people did not see climate change as a cause of major concern, let alone a reason to migrate, and those who were planning to migrate did not cite climate change as the reason for doing so (which is echoed by McCubbin et al. 2015). Similarly, Van der Land (2017) refutes the assumption that environmental stress and associated resource dynamics are a dominant migration driver in regions of concern such as the West African Sahel, and instead points to the role of individual aspirations for educational opportunities and urban lifestyles. Slow-onset environmental changes, Van der Land (2017) claims, may prove to be less significant migration drivers than the literature and media might suggest. Likewise,

4 In the case of climate change, Ferris (2012) distinguishes between migration, displacement and planned relocation.

social capital is an important aspect of individual and household migration decisions. In the Punjab region of Pakistan, one study noted a strong link between families' social links and the extent of rural to urban migration (Imran et al. 2016). Bukari et al. (2020) note that resource scarcity and climate change are factors in the migration of pastoralist groups such as the Fulani in West Africa, particularly in terms of the relatively favourable conditions in Ghana that may attract some pastoralists to the area. However, other factors were also involved, such as labour demand for pastoralists, access to pasture, social networks and the scale of conflict in the area. Likewise, Bayar and Aral (2019) studied all large-scale forced displacement in Africa between 2011 and 2017. Their study found that civil and interstate conflicts, lack of democracy and poverty are the most important drivers of displacement, and that climate change has an indirect effect at best.

The role of governments has been downplayed but government does affect people's needs, aspirations and abilities to migrate, for example by setting permissive or stringent migration policies

In fact, the role of governments has been downplayed but government does affect people's needs, aspirations and abilities to migrate, for example by setting permissive or stringent migration policies. Martin (2012) proposes that legal and institutional responses shape patterns of mobility in response to slow-onset situations, arguing that immigration policies, governance and the relative level of governance play a crucial role in affecting individual responses to natural hazards and conflicts. A study for the European Union (Barbas et al. 2018) noted that slow-onset events such as droughts and land degradation are relevant to outmigration from rural areas, but that the population's migratory response depends on people's ability to adapt to new conditions, institutional capacity, the effectiveness of resource management and sustainable development policies.

Although migration and displacement (and, to a lesser extent, planned relocation) are usually studied as impacts of environmental change, the most vulnerable people are not necessarily the ones most likely to migrate, or even to become displaced, as they may lack the means to move at all (Brown 2008). At the same time, diminishing resources may create or exacerbate a need for migration and migration itself requires resources. In the context of international migration (not environmentally related), de Haas (2010) challenges the conventional idea that development in (presumably poorer) countries of origin will reduce international migration in the form of people moving to benefit from relatively higher levels of wealth in destination countries, instead suggesting that higher levels of development generally lead to higher levels of migration, with people requiring a certain level of financial resources.[5] In fact, the third outcome – immobility – has rightfully attracted increasing attention in recent years as one of the key non-linearities in the relationship between environment and human mobility (Adams 2016; Blondin 2020; Nawrotzki and DeWaard 2018; Zickgraf 2019).

Environmental changes may, for instance, erode household resources in such a way that migration becomes less rather than more likely, even in the context of resource changes that threaten livelihoods (Geddes et al. 2012). Afifi et al. (2015) conducted a field study of the dynamics of rainfall variability, food insecurity and human mobility in eight countries.[6] They noted a wide range of outcomes: some households could harness migration as a successful adaptation strategy, while others move but are subject to even worse conditions, while others become trapped in situ. However, it is important to note that immobility is not necessarily involuntary despite the strong emphasis on notions such as trapped populations. Many people will, even in the most adverse of circumstances, choose to remain in place (Adams 2016; Farbotko 2018; Zickgraf 2019). In fact, Szaboova et al. (2021) show that people continued to stay in environmentally fragile areas because of their attachment to the place. Whether by force or choice, immobility may increase the risk for a number of adverse consequences related to a changing resource availability, access and use - including displacement (Foresight 2011).

5 Yet, this may only be true up to a point: a 2018 report for the European Union points to middle income countries rising GDP per capita being associated with higher migration levels, whereas in high income countries, higher GDP per capita is associated with lower migration levels (Barbas et al. 2018).

6 Ghana, Tanzania, Guatemala, Peru, Bangladesh, India, Thailand and Viet Nam.

Side box 2: Low-lying islands, natural resource changes, well-being and (im) mobility

I. Kelman

Residents of low-lying islands face major natural resource changes, as has occurred throughout history. Similarly, migration has always been one response to these changes. Today, diasporas send back remittances while temporary migration occurs for education, seasonal work and fun. These forms of migration are mainly voluntary, involving people who choose to seek other opportunities, although the lack of educational facilities or jobs effectively forces migration. At other times, migration is mainly forced, such as a cyclone or tsunami flattening an island, although it is arguably a choice not to provide resources over the long term to reduce vulnerabilities to these environmental processes that result in disasters.

At the same time, modern waste (including plastics and batteries) damages ecosystems (Farrelly et al. 2021; Lavers et al. 2019). Some people in Kiribati mine sand or use harmful nearshore fishing practices, while offshore industrial fishing depletes stocks. For Kiribati, Mangubhai et al. (2019) document how cockle harvests have dropped to under 10% of values from a generation ago, while sea cucumber exports took five years to drop to less than a quarter of their peak in 2007. As the consequences undermine local livelihoods, people may feel compelled to move.

Nuances emerge in analysing these situations. Migration from (or to) low-lying islands should not be feared. It can yield opportunities and improved services, and is not always undesirable. Many Marshallese seek to emigrate to the United States in order to improve their education, assuming that it will be better at destination, but remain connected to their lands of origin through visits (McClain et al. 2020). Nevertheless, fundamental questions remain as to how to ensure services and opportunities are equitable in order to give people choices about staying or leaving.

To avoid forced displacement from low-lying islands due to natural resource changes, there are ways of supporting adjustment to new circumstances. Where precipitation decreases, drought-resistant crops could be explored. As the salt content of subsurface water increases due to sea-level rises, local desalination and salt-resistant crops could be brought into play.

People living in low-lying islands do not want to be perceived as passive victims who accept whatever happens to them, such as natural resource changes or forced displacement. They can and do make their own decisions to adapt, based on their own values and interests, sometimes with external support or collaboration and sometimes alone (Kelman 2018; Moncada et al. 2021). People from the Marshall Islands and Kiribati have pursued "migration with dignity" as their slogan (McClain et al. 2020), explaining that, if they must move or choose to move from their islands, then they will do so on their terms rather than being seen to require aid in order to flee, without other options.

Many aspects are nevertheless outside the hands of residents from low-lying islands, such as human-caused climate change and anti-immigrant sentiments. However, many islanders remain optimistic about their abilities to adapt to ever-changing local circumstances by staying or migrating. In terms of migration, Marshallese (McClain et al. 2020) and Maldivians (Baldwin and Fornalé 2017) are following well-established pathways of leaving their countries to improve their living conditions and opportunities, without climate change being a significant influence on these decisions.

Not all choices produce positive outcomes. For those staying, local choices to modify food preferences in the Marshall Islands have increased obesity and diabetes (Davis et al. 2019). For those leaving, the large number of Tuvaluans settling in New Zealand has led to a loss of Tuvaluan languages and cultures (Samu et al. 2019).

Furthermore, many residents of low-lying islands want to move, but lack the resources or opportunities to do so. Forced immobility means "trapped populations", often characterized by persistent poverty with few possibilities for preparing for and addressing natural resource changes, as detailed by Taupo et al. (2018) for Tuvalu. As with migration, immobility is part of the cultures and histories of people living in low-lying islands, with many preferring to remain on their land with their ancestors and heritage, irrespective of difficulties and suffering. Noy (2017) explains that many Tuvaluans do not feel that they could leave their country now due to resource-related challenges, so instead they "stay and voice" in order to advocate for action that supports them.


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For migration and immobility, day-to-day concerns and desires can be used by locals and external partners to improve choices and actions (Ayeb-Karlsson 2020a). One example is natural resource changes and subsequent migration/immobility affecting physical and mental health and well-being. The rapid changes in natural resources can make local knowledge on food, water, energy and livelihoods outdated and counterproductive for daily and longer term health needs. Functioning and resourced health systems with qualified and dedicated staff; destigmatization of health needs such as family planning and mental health and well-being; and initiatives to adapt outmoded practices all support good health, non-destructive natural resource use, suitable adjustment to changes and opportunities for migration or immobility.

Foresight, planning and collaboration are needed to emphasize positive change and sustainable activities that can be developed and implemented by the residents of low-lying islands themselves. In 2014, the Kiribati Government purchased land in Fiji to support Kiribati's need for natural resources, although many in and outside Kiribati misinterpreted the situation as preparing for climate change migration (Hermann and Kempf 2017). Maldives, under various presidents, has pursued a policy of land reclamation and island construction (Naylor 2015), seeing and planning for a future irrespective of natural resource changes.

Terms such as "climate refugees" can be counterproductive and deterministic while limiting policy options and being legally inaccurate, so should be avoided. Instead, both migration and immobility form part of the needed and desired context for people living in low-lying islands to deal with natural resources changes, some from local activities alongside many more imposed on them from outside.

2.3.2 Spatial and temporal dynamics of human mobility linked to resources

The role of resources in triggering displacement or encouraging migration has an important bearing on the resulting forms of migration and displacement (Brown and McLeman 2013). This occurs along two main axes: spatial (where people go) and temporal (how long they leave for). Findlay (2011) notes that relatively little academic attention has been paid to places to which migrants might move - a data gap that persists today. However, as with the causes of migration and displacement, the resource picture also affects where people might choose or be forced to move (Kniveton et al. 2008). The dearth of literature is indicative of the historic lack of emphasis placed on the context and nuances of the spatio-temporal dynamics of mobility (Safra de Campos et al. 2017).

De Souza Ferreira Filho and Horridge (2020) suggest that climate change's impact on agricultural productivity in the north-east of Brazil could restart patterns of migration last seen in the 1970s, with unskilled migrants streaming south to the urban centres of São Paulo and Rio de Janeiro. A 2004 study in Burkina Faso showed that people from drier regions are more likely than those from wetter areas to engage in both temporary and permanent migration to other rural areas (Henry et al. 2004).

Most migration related to environmental change occurs along pre-existing routes (Black, Kniveton and Schmidt-Verkerk 2013). Despite fear-based portrayals of mass international migration from lower to higher income States, evidence strongly indicates that most people who migrate or are displaced for reasons linked to resources or environmental change move within their own country or region (Ionesco, Mokhnacheva and Gemenne 2017). This is particularly true when rural, agricultural (natural resource-dependent) livelihoods are disrupted or rendered untenable, and with a particular trend in migration from rural areas to urban areas (de Sherbinin et al. 2012). It should be noted however, that rural-to-rural, urban-to-rural and urban-to-urban mobility also occur. Most researchers report that international mobility is a smaller portion of overall movement resulting from environmental and resource changes (McLeman and Gemenne 2018). However, populations certainly can and do move across national borders. Internal or international and rural or urban migration trajectories are often shaped by social networks and support systems, where social capital might encourage and facilitate mobility. For example, the Nawrotzki et al. (2016) study of migration patterns and climatic change in rural Mexico between 1986 and 1999 found a stronger relationship for international migration (to the United States) rather than internal migration, which the authors ascribed to the presence of strong migrant networks in the United States, as well as climate-related changes in wage differences. Displacement also takes place across national borders, especially in regions where borders are permeable and international migration is not necessarily long distance (Abbas Khan et al. 2019).

Closely linked to the question of how far people move is the period of time for which they move. Mobility takes many forms with people moving for different periods of time, depending on their means, their needs and existing migration systems (Ionesco, Mokhnacheva and Gemenne 2017). Temporary and circular migration has, of course, been a traditional way to adapt to the resources available in different seasons. Herders and hunters in the Arctic, Central Asia, Africa and South America have traditionally engaged in seasonal journeys: moving their herds or following their prey between different regions that support them (ibid.). However, environmental change and fluctuating natural resource dynamics have been shifting these traditional routes (Adger et al. 2014).

Temporary or short-term migrants are usually expected to return to their point of origin. This movement may be seasonal, based on harvest and crop seasons, for example (Antwi-Agyei et al. 2018). In the case of sudden-onset events, such as floods and storms, people will typically move temporarily, either in the case of evacuation or short-term displacement, returning to their original homes once the immediate risk has receded (Joarder and Miller 2013). People may also end up in protracted displacement situations if resources at the place of origin are unable to support a return, as may be the case for sea-level rises (Hauer et al. 2020; Benet 2020), major industrial accidents (Hunter et al. 2015) or natural disasters (Peters and Lovell 2020). For example, 10 years after the Haitian earthquake, thousands of people remain displaced (Benet 2020).

Moreover, economic and personal opportunities can turn temporary movement into a permanent move if the destination offers greater resource access, a more stable livelihood and people have an aspiration to stay (Black et al. 2013b). For instance, Islam and Shamsuddoha (2017) suggest that slow-onset changes in Bangladesh affecting local ecosystem services and livelihood opportunities appear to encourage people to undertake routine economic migration at first, but that this later turned into

permanent migration. Joarder and Miller (2013) suggest the probability of migrating temporarily or permanently may be significantly affected by prior occupational experiences, particularly those tied to natural resources. In Bangladesh, for example, migrants who were farmers or fishermen are more inclined to move permanently.

2.3.3 A persistent gap: gendered dynamics

Current studies often focus on the household level, sometimes to the detriment of intra-household dynamics and inequalities, thereby creating a blind spot in current knowledge. For instance, only a handful of studies within the environmentally induced migration sphere have broached the issue of gender and migration (Chindarkar 2012; Eastin 2018; Gray and Mueller 2012; Gioli and Milan 2018; Van der Geest 2009; Everrtsen and van der Geest 2020). Gray and Mueller (2012) conducted a longitudinal study of the Ethiopian highlands during periods of drought. They showed that men's labour migration increased with drought but that marriage-related moves by women decreased with drought, highlighting the multiple dimensions of adaptation to environmental change. In contrast, Joarder and Miller (2013) argue that, in Bangladesh, it is women who are more likely to migrate temporarily as a survival strategy in the face of environmental challenges. A study in the Philippines argued that the most likely to migrate are young, connected, more educated men, whereas older people are less likely to migrate, regardless of income level (Bohra-Mishra et al. 2017). Myrttinen (2017) notes the differential impact that environmentally induced migration has on gender relationships but argues that much of the analysis has been based on relatively simplistic stereotypes. Gioli and Milan (2018) argue that migration is often strongly defined by gender roles and propose a feminist political ecology framework as a useful way of analysing the intersections between knowledge, power and practice. Seeing gender and other individual demographic and social variables as mediating factors to research may help further understanding of the forms and dynamics within the resource-mobility nexus.

2.4 Resources and the impacts of human mobility

Studies tend to agree that migration, displacement and immobility are multi-causal, and that natural resource availability and use, populations' livelihood dependence and resource management are often intermediaries in the environment-migration nexus, if not always the primary ones (Ionesco, Mokhnacheva and Gemenne 2017). This is the case at origin points, but also in transit and at destinations. The role of resources in triggering a spectrum of human mobility - either by necessity, opportunity or a combination - has an important bearing on the resulting forms of migration and displacement, and subsequently, the impacts of those movements (Brown and McLeman 2013). This is not a process in which migration or displacement ends upon arrival, as implied by the emphasis on migration drivers. The impacts of mobility feed back into socioecological systems and affect resources of migrants, communities of origin and destination communities (Guadagno 2014, 2017). This underscores the need to investigate resource availability, access and use within socioecological systems at the macro, meso and micro-levels, and the role of human mobility within them, including its impact on the entire system. Desai et al. (2021) note that, despite growing demand for comprehensive risk assessments that include displacement, due to complex causation and poor data, the longer term economic impacts of climate-related displacement are often hidden.

Underlying much of the debate over the impacts of mobility has been a calculation, often unspoken, as to whether the cumulative impacts of migration and displacement represent a net positive (to be encouraged) or a net negative (to be discouraged). De Haas (2010b) notes that the debates on migration and the impact on development have swung back and forth between development optimistic approaches in 1950s and 1960s, to neo-Marxist pessimism in the 1970s and 1980s and back towards a more optimistic outlook since then. These differing perspectives are present in the literature: Nicholson (2014) notes that the discussion about resources and migration is often framed by a concern about its causal impacts on the societal status quo. Nishimura (2015) argues that the primary focus should shift from the national security of developed countries to the particular needs of migrant populations themselves, as this would help migration to be included in adaptation strategies. The specific drivers and forms of displacement and migration determine the balance of these impacts on resources and, in turn, on sustainable development, politics and security. Ultimately, this has a bearing on whether migration is viewed as a net positive or a net negative phenomenon (Black et al. 2011).

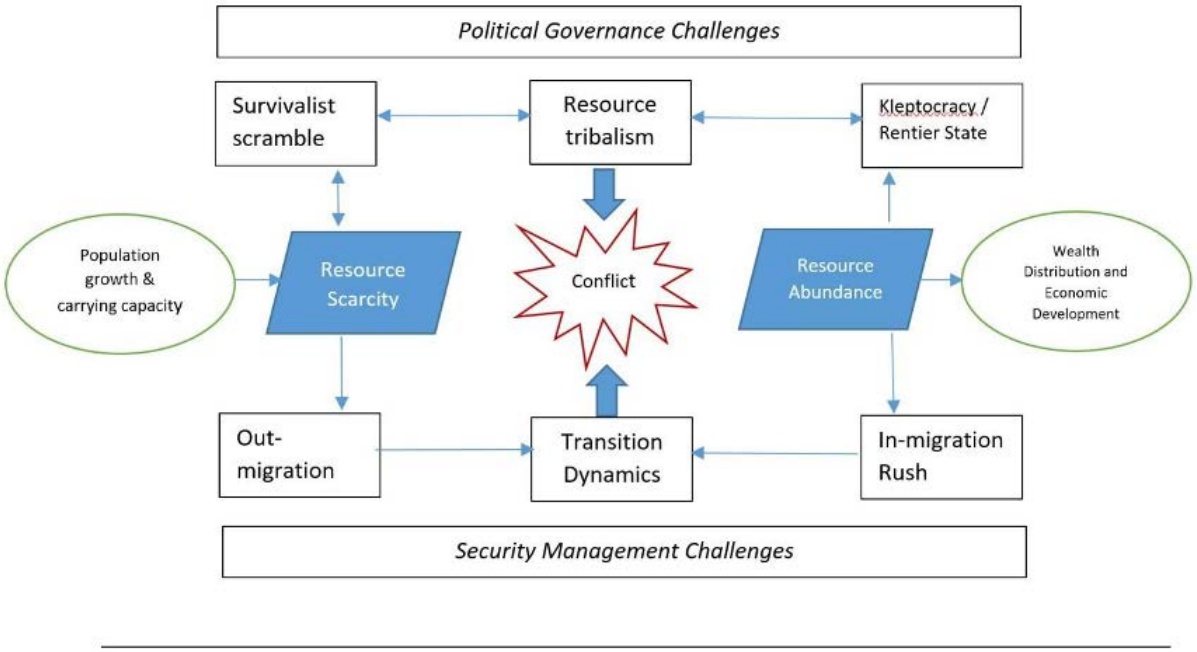

Figure 4. Pathways linking natural resource availability, conflict, security and migration in the literature

2.4.1. Resources, conflict, security and human mobility

Human mobility has been oversimplified in terms of causes but also outcomes, which are explicitly or implicitly assumed to be a national or international threat. Forced displacement can undermine development in at least four ways: by increasing pressure on infrastructure and services in destination areas; by undermining economic growth; by increasing the risk of tensions and conflict with communities at destination; and by leading to worse health, education and social indicators among migrants themselves (Brown 2008a).

Baldwin et al. (2014) argue that the spectre of migration plays a crucial role in the securitization of climate change, with climate-induced migration being used as a sort of shorthand to describe the security impacts of a warming climate. Much of the negative framing and fear-based portrayals of human mobility surround its potential (adverse) impact on peace and (international) security. In particular, migration and displacement are commonly cited as mediating factors in a pathway towards conflict (Adger et al. 2014). There are certainly examples of population movements leading to tensions and conflict over more scarce resources, often linked to competing livelihoods and/or ethnic groups with histories of tension. For example, Mbonile (2005) noted how people moving to the Pangani River Basin in Tanzania, partially in search of water, led to intensive conflicts between pastoralists and farmers, increased demand for water and decreased water availability in downstream areas.

McLeman et al. (2016) note that resource-related mobility can be linked to political instability (see Figure 4), but the security literature cautions against overly simplistic assumptions about cause and effect. Similarly, Dalby (2002) noted that deterministic claims about the relationship between environmental change, instability and migration are implausible given that conflict and mobility are complex socioecological phenomena. In fact, Nicholson (2014) warns that any ongoing substantive search for a causal relationship could be a blind alley that fails to analyse its assumptions and therefore allows the results to be politically manipulated. Consequently, links between natural resource availability, conflict, security and human mobility must be investigated cautiously rather than taken as read.

2.4.2. Resource benefits of human mobility: migration as adaptation

Although conflict over (scarce or abundant) natural resources can indeed lead to or result from migration and displacement, it would be unhelpful to overlook the benefits of human mobility for natural resource pressures in origin and destination communities and among migrants themselves (Gemenne and Blocher 2017). Migration and displacement are often described and treated as a function of vulnerability – an indicator of the limits of adaptation (Gemenne and Blocher 2017; Warner and Afifi 2014).

As a result, many policy interventions explicitly try to encourage adaptation measures in source countries as a way of reducing migration pressures and encouraging people to stay in their homelands (Gemenne and Blocher 2017). In the context of Bangladesh, Siddiqui et al. (2017) have shown how Government policy and programmes initially tried to portray migration as failure in local level adaptation. Over the years, the mindset of Government changed. However, such negative depictions of human mobility related to resources have recently been countered by a more optimistic reading: that, rather than being a symptom of a failure to adapt, migration can be an effective form of adaptation (Black, Kniveton and Schmidt-Verkerk 2013; Hunter, Luna and Norton 2015). After all, migration is already a widely used strategy to maintain livelihoods in response to social, environmental and resource changes (Adger et al. 2014). Pastoralist societies, which are reliant upon biological (flora/grassland) resources, are just one example of this. In many societies, seasonal labour migration has been a livelihood strategy for generations (Kniveton et al. 2008).

This perspective underpins the common usage of two theoretical frameworks: the Sustainable Livelihoods Approach (SLA) and the New Economics of Labour Migration (NELM) theory in studies of the environment-migration nexus (Kniveton et al. 2008; Van Praag and Timmerman 2019). The Sustainable Livelihoods Approach moves beyond simple push and pull factors to explain migration as part of a coping strategy available to households to build or maintain a socially and environmentally sustainable livelihood (Brocklesby and Fisher 2003; Kniveton et al. 2008). The range of possible coping strategies are determined by a household's natural, physical, financial, human and social assets (Sakdapolrak et al. 2016). For example, a study of temporary migration in Matlab, Bangladesh, attempted to predict the extent to which temporary migration was affected by temperature, precipitation and flooding (Call et al. 2017). Perhaps counter-intuitively, the study found that migration declines immediately after flooding but then returns to normal, whereas optimal precipitation and high temperatures increase migration over one to two-year periods. According to the authors, this challenges the common assumption that high temperatures and extreme weather events consistently lead to increased temporary migration, and the results support a livelihoods interpretation, in which households employ a range of ways to deal with environmental variability (ibid.).

From an NELM perspective, migration is not an individual decision, but a collective household decision made together with non-migrants. The departure of one household member offers a livelihood diversification and insurance strategy, protecting the migrant-sending household from adverse environmental or other changes (Stark and Bloom 1985).[7] The main mechanism of adaptation is financial remittances generated by the migrant and sent back to their non-migrant relatives.

However, the option of such adaptation is denied to those who lack mobility, leading to the prospect of increased numbers of people trapped in place (Black et al. 2011; Adger et al. 2015; Ayeb-Karlsson et al. 2018). Adger et al. (2009) note that adaptation to climate change, including the view of migration as an adaptive action, is formed and constrained by social factors such as cultural values, attitudes to risk and knowledge. These form societal limits to adaptation, but these limits are subject to change (Benveniste et al. 2020). However, this more optimistic reading of migration as adaptation is not without its critics. First, by narrowing the focus on migration as an adaptive response to environmental risks and resources, it ignores the major impacts of other forms of migration. Second, it does not address the other ways that people and societies deal with change, such as resilience building. Third, migration as adaptation has been interpreted in a way that justifies neoliberal migration policies (Bettini and Gioli 2016; Sakdapolrak et al. 2016).

7 However, it should be noted that NELM assumes that migration is a collective, harmonious household decision and has been criticized for overlooking intra-household dynamics including conflict and power imbalances and inequalities such as gender and generation within and outside environmental contexts (Gioli and Milan 2018).

Even when they are able to move, not all migrants, displaced individuals or their families will benefit, and maladaptive outcomes may also occur. Investigating migration as adaptation therefore prompts the question of who the adaptation is for, as well the need to examine differential resource costs and benefits for migrants, origin areas and destination areas (Gemenne and Blocher 2017).

2.4.3 Impacts on migrants and displaced people

People on the move can benefit from migration through increased economic and educational opportunities, for instance, or more secure resources. Although short-term displacement is commonly seen as a situation to avoid, it is often the best available option to protect against immediate risk. Even in displacement contexts, people's access to critical services like health care and food aid may improve their overall well-being when displacement is well managed and protection needs are addressed.

Nonetheless, migration has individual social and emotional impacts for people with understandable attachment to place, not just in a physical spatial sense but also in terms of culture, community and social networks. Because resources may be just one factor in mobility decision-making, migration does not necessarily or uniformly improve resource conditions. As Tabe (2019) notes in the case of relocated Pacific Islanders, people displaced by environmental change or who migrated in response are also exposed to potential new hazards and undergo changes in their own access to resources. A study of migration between 1970 and 2000 showed that migrants in developing countries have tended to move away from marginal drought-prone dryland and mountain areas towards coastal ecosystems and areas that are prone to floods and cyclones (de Sherbinin et al. 2012). In Bangladesh, permanent migration caused by slow-onset resource changes can increase poverty, especially for women, older adults and the disabled (Islam and Shamsuddoha 2017). In Peru, Carrasco-Escobar et al. (2020) calculated the extent to which internal migrants are exposed to higher levels of air pollution through having moved from rural areas to poor urban neighbourhoods.

The limited formal legal protections available to people who cross borders as a result of environmental stress or natural hazards have been the subject of increasing attention and concern over the last decade (Gemenne and Brücker 2015; Zetter 2011). International legislation on refugees, the environment and human rights does not account for resource-related displacement, thereby reducing the potential protection available to people (Nishimura 2015). For instance, according to Zetter's (2011) assessment of the capacity of national legal systems to protect the rights of people displaced by environmental stress in four countries,[8] although all experienced environmental displacement as an enduring phenomenon due to their resource-dependent economies and fragile ecosystems, while acknowledging the existence of environmental migrants, none of the legal systems assigned a specific legal status to those migrants and internally displaced persons (IDPs). This was partly because of the politically sensitive nature of the issue. One of the most innovative elements of the Global Compact on Safe, Orderly and Regular Migration, signed in 2018 by 164 States, was that it explicitly recognized the nexus between climate change and migration (Kälin 2018).

2.4.4 Impacts on communities of origin

The impacts of outmigration on communities of origin echo the debates within the broader literature on migration and development. While migration and displacement can have a significant impact on resources in migrants' areas of origin, the form of impact varies from one context to another based on multi-scalar socioeconomic, environmental, political and demographic interactions. As mentioned above, temporary outmigration is already a coping strategy for communities living in areas affected by environmental stress, enabling mobile community members to search for work externally to both send remittance money home and reduce the overall number of people to be fed at home (Brown 2007; Sakdapolrak et al. 2016).

Research tends to focus on the economic dimensions of the environment-migration nexus, primarily by seeing how financial remittances can decrease reliance on local, rural, natural-resource based livelihoods. However, outmigration can also help to increase social resilience in communities of origin by transferring skills, knowledge, technology or "social remittances". Migrants can therefore help drive adaptation to environmental and resource change and stress within socioecological systems in less material ways. For instance, the movement of migrants can build and extend social networks that facilitate future migration, thereby continuing the chain of migration (Brown and McLeman 2013) and helping to escape

8 Kenya, Bangladesh, Viet Nam and Ghana.

the perils associated with involuntarily immobile and displaced populations.

According to research into eight[9] international case studies that assessed a range of rainfall-related climatic events such as floods, drought and seasonal shifts, outmigration can be a successful temporary adaptation strategy for communities of origin (Afifi et al. 2015; Sakdapolrak et al. 2016). This can decrease local pressures on natural resources in the place of origin, but also denies those communities valuable human resources, as it is often members of the active labour force who are most likely to migrate. The same eight countries were included in a study (Warner and Afifi 2014) that distinguished between different forms of migration undertaken by households that were resilient or vulnerable. Vulnerable households were more associated with what the authors called erosive coping. This meant that migration that did not build resilience of the host community, for example, if remittances did not get through (thereby exacerbating food insecurity in the community of origin).

In the Global South, extensive rural-to-urban migration coupled with falling birth rates is affecting the distribution of populations as well as shifting resource use and management.

In the Global South, extensive rural-to-urban migration coupled with falling birth rates is affecting the distribution of populations (Schaeffer 2017), as well as shifting resource use and management. McLeman et al. (2016) note that environmentally induced migration is also contributing to socioeconomic inequality in sending areas, as mobility is available to those with the social, personal and financial resources to move. The benefits of migration are therefore unequally distributed (Zickgraf et al. 2016). The case of coastal Viet Nam exemplifies the complex forces at work in terms of the resilience of source communities. Here, emigration is occurring alongside but not driving the expansion of unsustainable coastal aquaculture. Increasing economic inequality undermines social resilience but remittances and economic diversification are beneficial for resilience (Adger et al. 2002). Meanwhile, international competition for highly skilled workers helps to accelerate the brain drain effect, which can further undermine development prospects in communities of origin (Schaeffer 2017).

2.4.5 Impacts on communities of destination

One lesser explored aspect in the resource-migration nexus is the impact on communities of destination. Migrants are also a resource for communities of destination: a labour resource, but also a resource for national and international connection, bringing with them skills, knowledge and technology. In other words, social remittances go both ways (Mazzucato 2011). Schaeffer (2017, p. 300) notes that large incoming population movements, be they migrants or people displaced by environmental stressors, can also have a significant impact on resources in destination communities – often disrupting and changing the "inherited order of things". This is the case both in higher and lower income countries. In fact, migration is becoming a major driver of demographic change in advanced industrialized countries where birth rates have plummeted, and the domestic population looks likely to shrink in coming decades.

However, in-migration can also put pressure on local natural resources, particularly when governance systems are weakened or fragile. Bryceson and Massinga (2002) describe how, in the Mecúfi district of northern Mozambique, in-migration of people to coastal areas following the civil war increased the strain on coastal resources and introduced new systems of governance that merged with some of the traditional forms of resource management. In-migration in Ethiopia has been linked to land degradation in destination regions (Hermans-Neumann et al. 2017). Indeed, experience shows that managing in-migration can be a challenge at all scales. Owen and Kemp (2017) describe how many extractive companies lack the social management structures to deal with resource rush in-migration to large commercial mining sites.

These three areas of impact can help answer the question of who adaptation is for, by highlighting that migration may be beneficial for some, but not for others (Gemenne and Blocher 2017). Nonetheless, from a systems approach, impacts on migrants, communities of origin and destination must be seen collectively as they interact rather than in isolation. In terms of resources, the depletion or overuse of resources at destination may stimulate further migration, while successful migration can allow family members to stay in communities of origin

9 Guatemala, Peru, Ghana, Tanzania, Bangladesh, India, Thailand and Viet Nam.

by decreasing their dependence on local natural resources or enabling non-migrants to invest in infrastructure such as irrigation systems. Ill-equipped or underprepared destination areas may limit the adaptive potential of migration and sustainable development by hindering migrants' ability to secure and send remittances, as well as to improve their own well-being.

Black et al. (2011) challenge the conventional narratives that place migration in a negative light, arguing instead that migration offers opportunities as well as challenges. They note that the greatest risks are borne by those who are unable or unwilling to move, and that those people may become even more vulnerable if politicians impose restrictive policies designed to stop migration. According to McLeman et al. (2016) and de Haas (2010b), there is no consensus on whether environmentally induced migration is desirable or undesirable, and the empirical evidence does not support a completely positive or negative assessment of the impacts of migration. This study adopts a socioecological system approach and understanding, which focuses on complexity and adaptation in order to reframe human and ecological factors in a process of coevolution, whereby mobility can be an important indicator of stress or positive adaptation.

[...] the greatest risks are borne by those who are unable or unwilling to move, and that those people may become even more vulnerable if politicians impose restrictive policies designed to stop migration.

2.5 Integrative lessons

Most experts expect environmentally induced migration to grow in the coming decades as a result of climate change and global demographic patterns (McLeman et al. 2016; Rigaud et al. 2018). However, there is no certainty about the scale of the increase in such movements (McLeman et al. 2016). The various above-mentioned links between resources and migration underline the importance of understanding the unique context and circumstances of each case (Rigaud et al. 2018). Black, Kniveton and Schmidt-Verkerk (2013) note that the push and pull factors may apply in one circumstance but not elsewhere. The focus on local context and individual cases over multi-case and comparative studies has prevented the development of global narratives on the links between natural resources and human mobility (Gemenne 2018). Hunter et al. (2015) argue that the research agenda should move beyond linear theories of environmental push or economic pull towards a greater appreciation of context at all levels.

In the meantime, the implementation of effective policy responses to environmentally induced migration and displacement has been limited by four interlinked issues that have sapped international political will to find commensurate solutions. These are: the absence of a recognized definition of the phenomenon; disagreement over the number of people affected; legal issues surrounding people's rights within the international system; and challenges in providing services to people displaced internally and across borders (Assan and Rosenfeld 2012; McAdam 2016).

Resources, and current systems of resource governance, access and benefit sharing, underpin many of the dynamics of so-called "environmentally induced migration", and also what has been called "economic migration". The relationships among resources, migration and displacement are complex. De Haas (2010) argues that migration needs to be conceptualized as part of wider development challenges, rather than as a stand-alone issue that needs to be solved.

Issova et al. (2020) argue that seeing environmentally induced migration through the prism of the United Nations Sustainable Development Goals (SDGs) provides the sort of interdisciplinary, comprehensive approach that enables a balanced view of the impacts of migration. Tacoli (2009) argued that policymakers need to shift their perspective away from seeing migration as a purely negative phenomenon. It is important to better understand how migration will affect and interact with other social trends such as the growth of cities, the co-existence of cultures and the formation of poverty traps (Black et al. 2011; Oliver-Smith 2012).

Researchers have proposed numerous policy responses. Natural resource management systems need to be able to deal with different temporal, social and spatial aspects; nested hierarchies; and the multidimensional properties of a dynamic system (Rammel et al. 2007). Édes and Gemenne (2015) suggest that climate-proofing infrastructure should

be a policy priority, particularly in Asia and the Pacific, to build resilience for communities vulnerable to disaster-related displacement. New governance mechanisms are needed to deal with complexity and uncertainty (Warner 2010). Different forms of adaptive governance (Folke et al. 2005) polycentric governance (Ostrom 2010) and multi-level governance (Termeer et al. 2010) are proposed to help understand the dynamic complexity of environmental governance in a way that includes natural resources and mobility. Although common property resources can create community resilience in terms of shared capacity to adapt, extensive degradation of the resource can still lead to involuntary displacement of these communities, as demonstrated by extensive research, particularly in India (Chopra and Gulati 2001; Mahanta and Das 2013).

Resource management systems might hold the key to drawing some of the political poison out of contested views of migration and displacement and maximizing its benefits

Resource management systems might hold the key to drawing some of the political poison out of contested views of migration and displacement and maximizing its benefits. However, appropriate policy responses require these relationships to be better understood. There remains a lack of understanding around how different resource-related policies and programme initiatives influence the potential for migration and displacement, and what best practices should be profiled and mainstreamed (McLeman et al. 2016).

The governance challenge inherent in tackling environmentally induced migration is twofold: there are relevant actors at the local, national and international levels, and there is also a horizontal fragmentation as the phenomenon is rarely dealt with separately but is addressed by multiple initiatives in different ways (McAdam 2009). Gemenne et al. (2017) note that putting in place mechanisms and structures for migrants and IDPs are necessary steps to attenuate future risks. They argued that regional authorities must work together to strengthen the resilience of communities of origin, as well as facilitating migration as a form of adaptation.

Ultimately policymakers need to address both sides of the environment-migration nexus: on the one hand, by implementing adaptation strategies that allow people to remain in place and, on the other, by identifying migration and relocation strategies that protect people's lives and livelihoods in places where they are unable to stay

Ultimately policymakers need to address both sides of the environment-migration nexus: on the one hand, by implementing adaptation strategies that allow people to remain in place and, on the other, by identifying migration and relocation strategies that protect people's lives and livelihoods in places where they are unable to stay (Martin 2012).

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3

MAPPING DISPLACEMENT, MOBILITY AND NATURAL RESOURCE USE

Key messages

1. International spatial patterns of natural resource demand are determined by international and internal migrant flows and by supply chain linkages between places of resource extraction and end use. International migrant flows show some links with natural resource availability (although the examples involved are very context specific).

2. Globally, the top 200 recent hydropower developments (2000-2018) are estimated to have displaced between 900,000 and 2 million people and induced substantial land-use change since the start of the century. While new hydropower infrastructure is typically developed in remote areas, a large number of current and expected projects will probably displace large numbers of people globally.

3. Refugees often have little agency in selecting the camp's location or in immediately accessing surrounding natural resources. Refugee camp establishment is associated with rapid land-use changes. In contrast, activities by camp inhabitants (such as fuelwood gathering and subsistence farming) often constitute productive land use around and within the camp (where access and use are permitted). It is critical for research and effective policy formulation to consider the impacts of socioeconomic vulnerability, freedom of movement and host community relations on natural resource access and dependence for refugee camps.

4. Resource rushes are often accompanied by relatively discrete inwards mobility events and abrupt land-use changes for settlement establishment and mineral extraction. Under current resource extraction pathways, such rushes are typically characterized by trade-offs between improved socioeconomic outcomes for migrants (and local communities more generally), and widespread environmental externalities.

3.1 Introduction

Human movements occur along a space-time continuum involving a range of distances; seasonal movements in the form of temporary or permanent international moves; and fractured and non-linear journeys within and outside countries of origin (Amrith 2021). The distinction between migrants and refugees to categorize the conditions and needs of cross-border journeys has been criticized for reinforcing exclusion and limiting understanding of migration processes (Crawley and Skleparis 2018).

In terms of the complex ways in which environmental change could trigger mobility processes, and how relocation might drive resource exploitation and degradation, data gaps are making it more difficult to carry out global assessments of the relevant phenomena. Consistently collected and comprehensive migration datasets are limited and often lack detailed information about movement trajectories to link places of origin and destination. Assessing environmental change at a global level requires selecting effective environmental responses and explanatory variables. However, the local heterogeneity of ecological systems and migration patterns further complicates global analyses. There is a need for innovative approaches in mapping international migration and understanding potential mechanisms tied to resource exploitation and degradation. Remotely sensed datasets and other georeferenced information are key in identifying spatiotemporal environmental changes in terms of mobility origin or destination points and corridors. Collaborative efforts between governments, humanitarian and academic institutions tracking and mapping movement can be a good starting point for building databases for openly accessible information on changing trends. The use of social big data by digitally tracing mobile phone use and online social networks has also been proposed for use alongside traditional census datasets to improve understanding of global migration patterns (Sîrbu et al. 2020). The regular collection of multi-modal data will therefore be critical for developing a holistic understanding of the connections between natural resource use and migration.

This report focuses on the natural resource-mobility nexus and explores the dynamic relationship between environmental drivers, resource exploitation, human mobility patterns and associated environmental change. The influx of migrants and refugees at destination sites can increase demand for food,

water, productive land and stimulate labour markets. Increased pressure on resources can alienate new arrivals and ruin their chances of establishing sustainable livelihoods. This isolation can leave incoming people vulnerable, essentially displacing them in place. At the same time, population increase may be associated with positive socioeconomic outcomes from a more productive, flexible labour market – provided that the workforce is skilled and a good fit for the host economy. Research has also shown that businesses may benefit from increased labour supply. In rural settlements where households tend to make additional income selling agricultural surpluses, increased demand for produce may improve household welfare (Alix-Garcia and Saah 2010).

Spatial datasets of land use and land cover, satellite imagery and georeferenced global datasets of artisanal mining sites, hydropower dams and refugee settlements were used to assess the environmental changes associated with displacement and migration. The goal of this chapter is to assess the dynamics of human displacement and land-use changes attributable to hydroelectric power development, mineral resource extraction and forced movement leading to encampment. Location-specific histories, social dynamics, political crises and economic changes are considered as compounding factors of displacement and mobility. The first section of the chapter examines the relationship between international mobility and land degradation using bilateral migration flows and the Sustainable Development Goal indicator 15.3.1, respectively (Section 3.2). The second section analyses the impacts of development-induced displacement on local ecosystems (in the form of land cover and population changes) in the wake of hydroelectric dam reservoir filling (Section 3.3). The third section explores the environmental impacts of forced migration events and resource rushes based on case studies of selected refugee settlements and mineral rushes (Section 3.4).

3.2 International mobility and natural resource degradation

As highlighted in Chapter 2, environmental change and migration are linked because efficient natural resource use may be a pull factor for human mobility (labour movement) driven by a complex interaction of resource access and availability, land use change and environmental degradation. At the same time, resource management can act in conjunction with sociopolitical conditions to further complicate mobility trends. The success of sustainable natural resource use largely depends on the effectiveness of governance mechanisms to regulate and monitor activities through regional and national policy, monitoring and regulations on issues such as land tenure, pollution and degradation.

Sustainable Development Goal (SDG) Indicator 15.3.1, which measures percentage degraded land with global bilateral flows, is mapped to examine the relationship between international mobility and land changes. Subsequently (see Chapter 4), statistical modelling is used to quantify associations between international mobility and natural resources. Major migrant flows (>50,000 people) are observed in and among all world regions (Figure 5). Countries experiencing large net outwards movement (such as India, China, Mexico and Nigeria) also appear to have high fractions of degraded land (Figure 5). This pattern is probably at least partially explained by the greater capacity of populous nations to produce large numbers of migrants, as well as the potential for more intensive domestic resource demand in highly populated nations. However, it may also suggest a more direct linkage between natural resource use and international movement, whereby there may be an observable influence of resource degradation on human mobility at the global scale. This is quantitatively investigated in Chapter 4.

In 2015, the destination of most international migrants was within their continent of origin, except for Oceania, where 56% of the outwards flow of people are destined for Asia (Figure 6). In Africa and Asia, 76% and 75% respectively of migrant flows were retained continentally. This indicates that intercontinental differences considered in the run-up to mobility decisions may be limiting movement beyond the continent of origin. Asia and Europe were the most mobile regions in 2015, with over 30 million and 20 million people, respectively, moving from and within each region. Intercontinental flows were significant in Europe and the Americas, which received 14 million and 9 million people from other continents. There is a need for yearly series datasets of mobility flows that might reveal long-term trends, convergences and regions of stability or volatility.

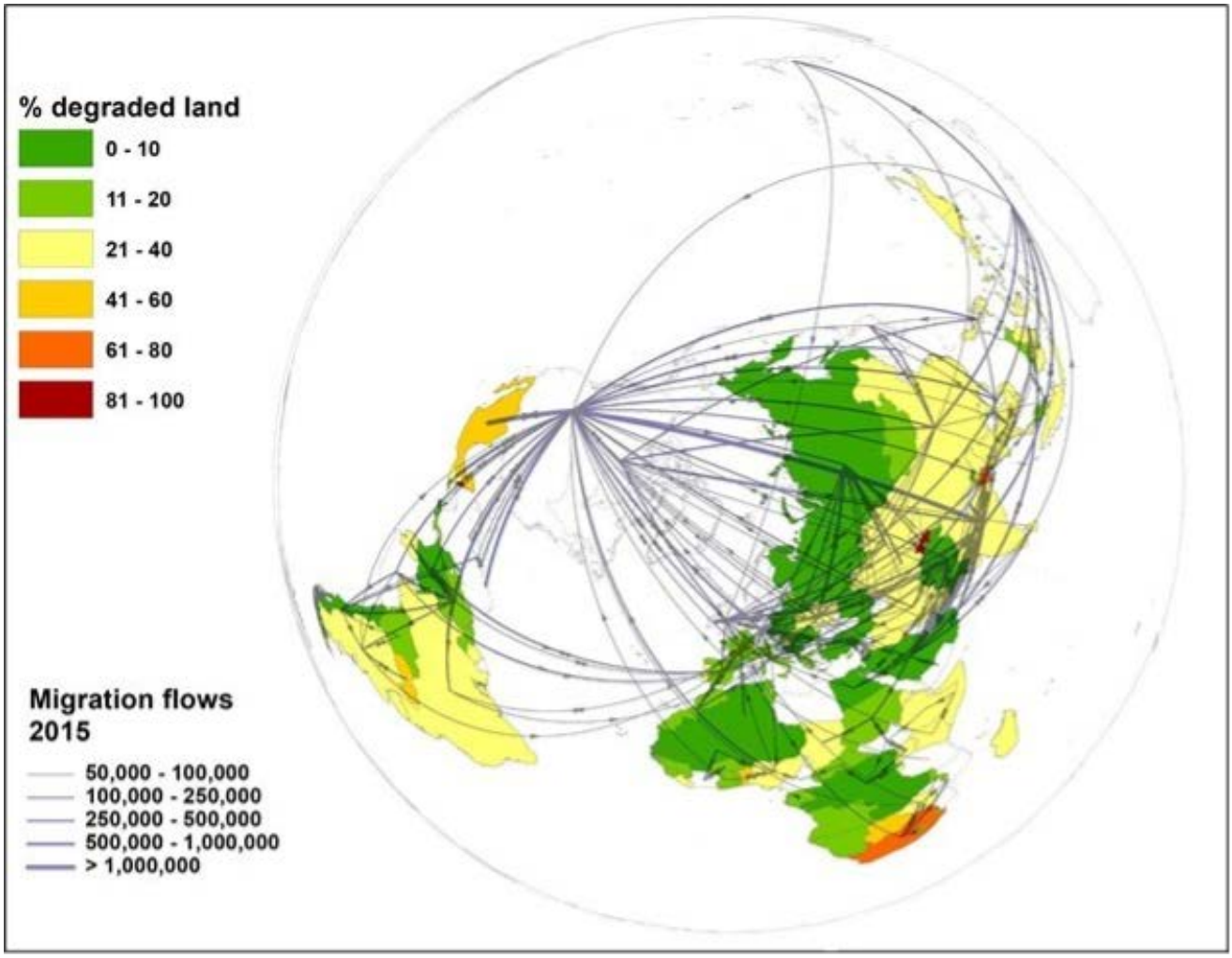

Figure 5. Global bilateral mobility flows for 2015, based on Abel and Sander (2014) and Azose and Raftery (2018). Flows greater than 50,000 people are shown. Sustainable Development Goal 15, indicator 3.1 - the percentage of degraded land, is mapped. This includes subindicators of land productivity, land use, land cover change and carbon stock above and below ground for 2015. Degraded land is based on changes in land cover, productivity and carbon stocks relative to the baseline year (2000), and is where there is a negative change relative to previous conditions. Countries shown in white have unreported data for SDG Indicator 15.3.1. More information on the data can be found in Appendix 8.1.2 A.

3.3 Displacement due to hydroelectric power infrastructure

Hydropower, the largest global source of renewable energy, accounts for about 20% of all electricity generated worldwide, and is used in more than 150 countries (World Bank 2000). In addition to power generation, most hydropower facilities are multifunctional, serving as flood controls, irrigation and water supply schemes and supporting shipping and navigation (Global Reservoir and Dam Database [GRanD] 2018). Hydropower development is the type of large-scale infrastructure investment that is often commissioned as a way of improving livelihoods, economic performance and national security. As a renewable energy source, hydropower dams offer a climate-friendly alternative to fuelwood and coal power generation. Hydropower is also a far less intermittent electricity source than solar, wind and tidal power because of its location in large perennial hydrological systems. Despite providing a better alternative to fossil fuel powered plants, hydropower infrastructure may be a significant source of greenhouse gas emissions (St. Louis et al. 2000; Demarty and Bastien 2011). Studies conducted in low latitudes have found that tropical dam reservoirs trap large amounts of organic matter, which then releases carbon dioxide (CO_2) and methane (CH_4) during bacterial decomposition (ibid.). Damming rivers can also negatively impact the quality and access to natural resources, with social and livelihood implications for riparian communities.

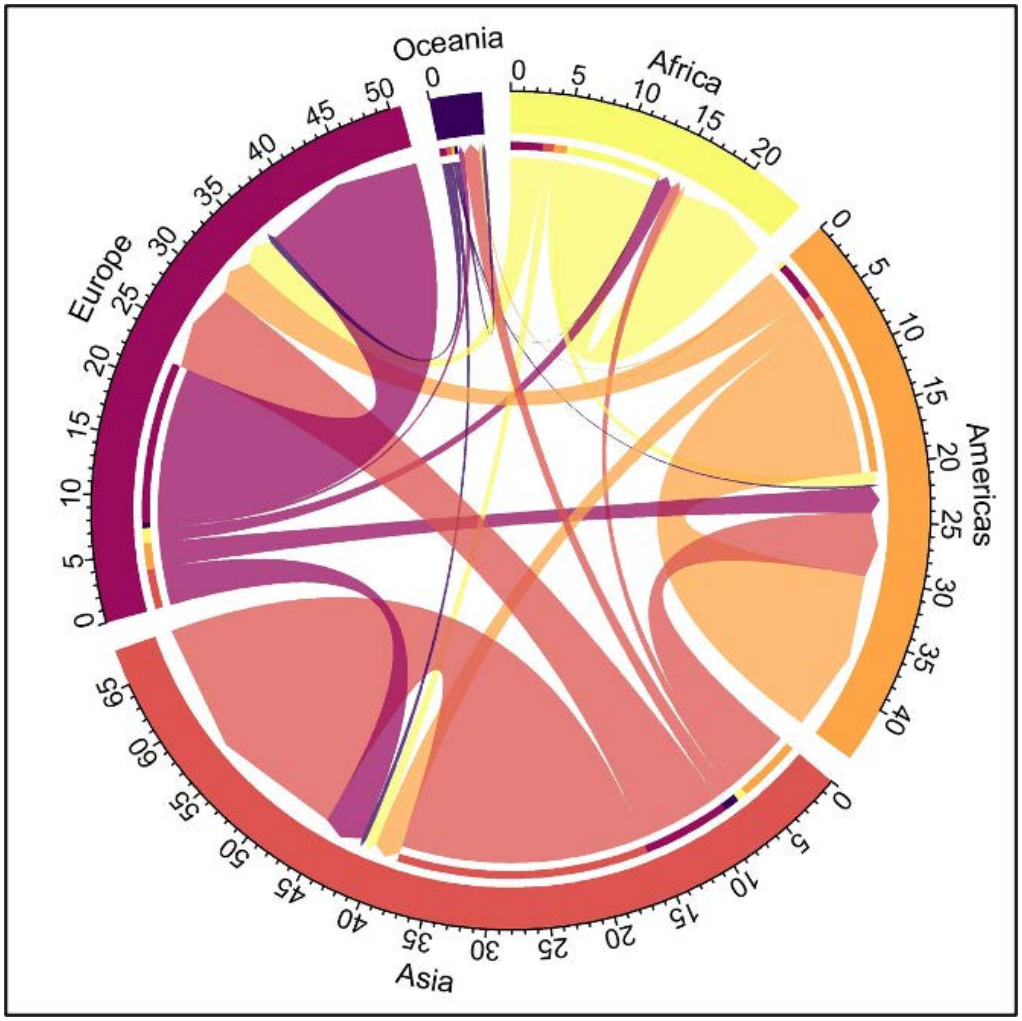

Figure 6. International mobility flows for 2015, based on Abel and Cohen (2019). The flows represent an estimated 95.8 million total international migrants. Units are in millions of people. Arrows are coloured based on the continent of origin and point toward the destination continent. Arrow heads correspond to the volume of movement. This figure shows that most migrations take place within continents and that, for inter-continental movement, Asia was the source for most migrations, and Europe the destination.

Studies have shown that large dams, which were constructed across the world in the twentieth century and beyond, impose multipronged impacts on biodiversity and change the hydrological regimes by altering the rivers' natural hydrograph, sediment and nutrient transfer and freshwater species diversity as a result (Fantin-Cruz et al. 2015; Latrubesse et al. 2017). Despite this, there is renewed demand for large hydropower infrastructure, as well as significant criticism over the socioecological implications of construction, reservoir filling and river basin modifications. A major cause of disenfranchisement among riparian communities near dammed rivers is their physical displacement in preparation for reservoir filling. Between 40 and 80 million people have been displaced by dams worldwide, and 10.2 million of these related to dam construction in China alone between 1950 and 1990 (World Commission on Dams 2000). Programmes to support the sustainable relocation of displaced communities vary widely in their comprehensiveness and efficacy (Side box 3).

The purpose of this section is to assess human displacement and land-use change driven by the construction and reservoir filling of recent hydropower projects (2000-2018). This time period was selected due to the availability of land cover imagery from the European Space Agency's Climate Change Initiative data archives (Bontemps et al. 2013). In addition, the final report from the World Commission on Dams evaluating the World Bank Group's financing of large hydropower dams was released in 2000, and there have been no comprehensive studies assessing the social and environmental impacts of large dams since then. This section quantifies the populations

who were at risk of displacement from hydropower dam construction and filling between 2000 and 2018 by comparing population changes before and after dam filling. The migration implications of upstream dam establishment for transboundary water bodies are also briefly explored. Besides displacement, ecological changes resulting from hydropower dam construction are examined by quantifying land-use changes associated with dam building and reservoir filling. Hydropower displacement presents a unique case study of displacement, resettlement and local livelihood changes to accommodate infrastructure development that addresses national and global energy demands using non-carbon energy sources.

Hydropower displacement presents a unique case study of displacement, resettlement and local livelihood changes to accommodate infrastructure development that addresses national and global energy demands using non-carbon energy sources

3.3.1 Displacement and land cover change due to hydroelectric dam construction

A map of all hydroelectric dams constructed between 2000 and 2018 shows three hotspots: China, Turkey and Brazil (Figure 7). A stacked area chart highlighted Asia's significant share of dams constructed during this period (largely attributable to increased hydropower development in China), with South America and Europe holding second and third positions.[10] Dam construction gained momentum between 2005 and 2014 (Figure 8A). After selecting 279 hydroelectric dams constructed between 2000 and 2018 from the Global Reservoir and Dam Database version 1.3 (2019), all dam points were combined with associated reservoirs, land cover maps and population datasets (Dobson et al. 2000; Center for International Earth Science Information Network [CIESIN] 2015) to estimate environmental and human population changes following dam construction and reservoir filling (Lehner et al. 2011). The population at risk of displacement was estimated by using the reservoir extent to calculate the total population residing in the area at the time (Appendix 8.1.1 B).

There was a 35% increase in the size of water bodies at dam locations between 2000 and 2018, which is probably attributable to reservoir filling for electricity generation. During the same time, an 18% decrease in tree cover was estimated as a likely result of reservoir clearance and filling (Figure 8B). China's Three Gorges Dam, Brazil's Luis Eduardo Dam and Ethiopia's Gilgel Gibe III Dam stand out in terms of visible population changes around dam reservoirs between 2000 and 2020. However, only the Three Gorges Dam showed a decrease in population.

There was a 35% increase in the size of water bodies at dam locations between 2000 and 2018, which is probably attributable to reservoir filling for electricity generation.

10 GRanD V1.3, 2019. http://globaldamwatch.org/data/#core_global.

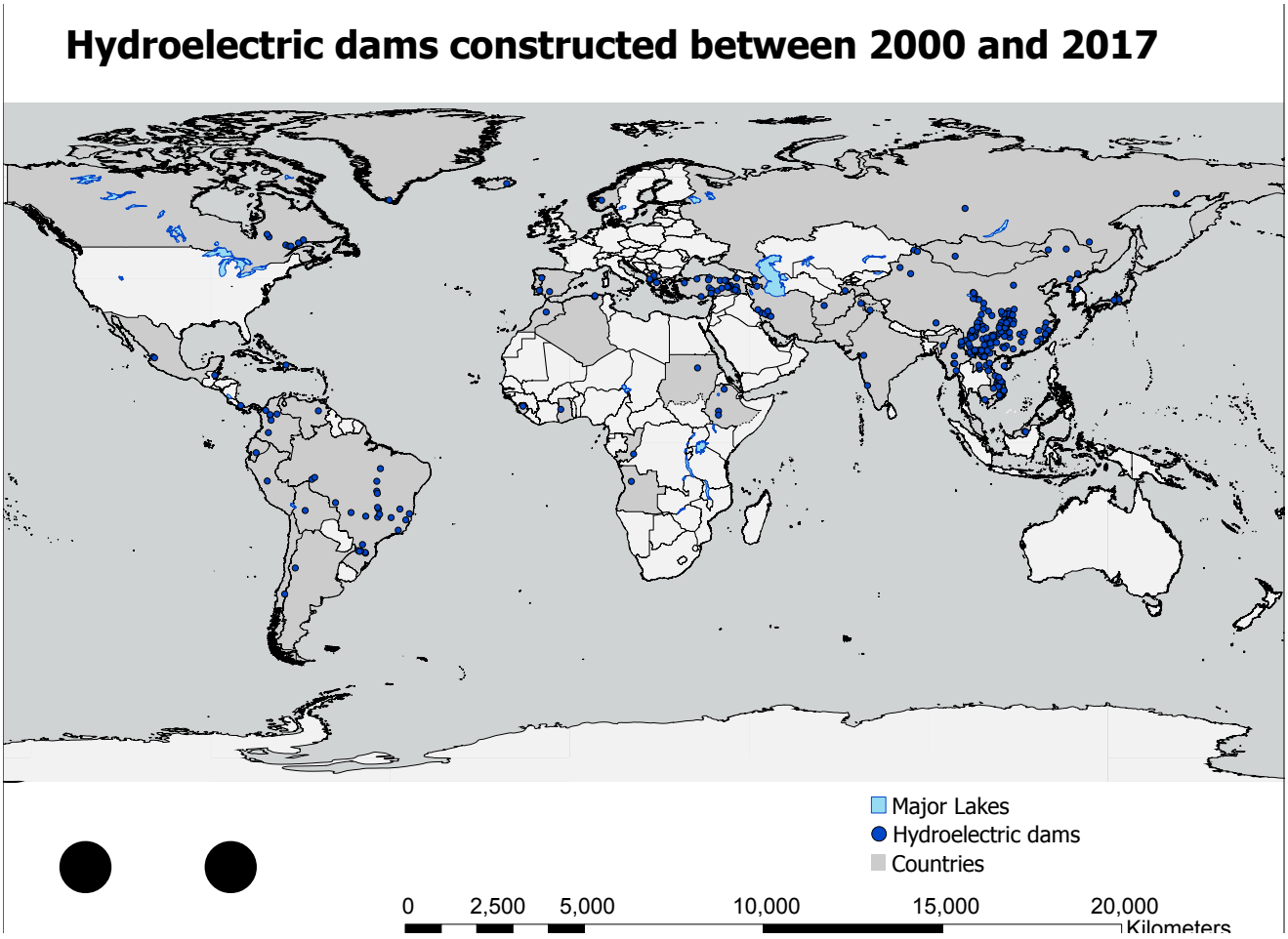

Figure 7. Global distribution of major hydroelectric dams constructed between 2000-2017. Republic of Türkiye, China and Brazil have a high number of dams

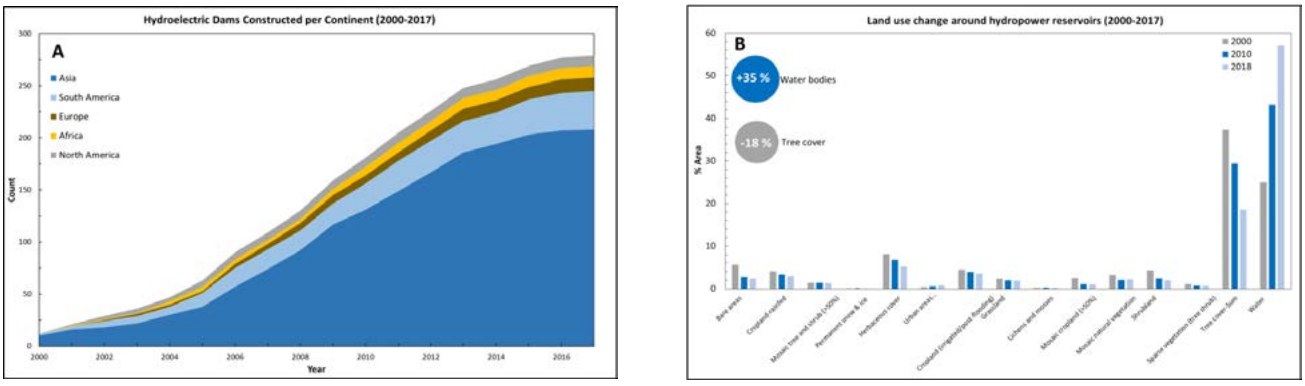

Figure 8. Trends in dam construction and associated land-use change. A stacked area chart showing cumulative hydroelectric dam construction by continent between 2000 and 2017 (A) and estimated land-cover changes in the reservoir areas of all selected dams (B)

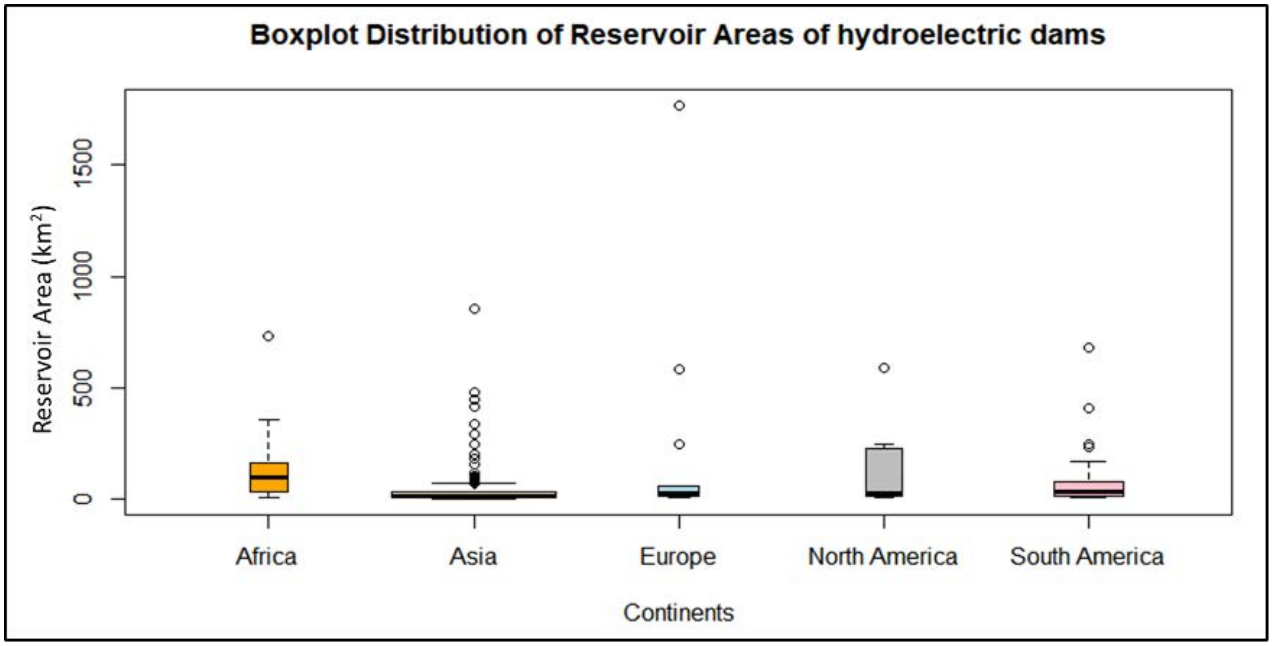

Figure 9. A box-plot distribution of dams categorized by continental location and reservoir area. Dams selected from the outliers. Ethiopia's Grand Ethiopian Renaissance Dam represents Africa, while the Three Gorges Dam in China represents Asia and Eastmain-1 in Canada represents North America

3.3.2 Case studies

Case studies were selected by a geographical categorization of dams by continent and also based on dams with large reservoir coverage (Figure 9).

a. Grand Ethiopian Renaissance Dam (GERD) - Ethiopia (2010-2020)

The Grand Ethiopian Renaissance Dam (GERD) was completed in 2020 on the Blue Nile River[11] near the border with Sudan. Dam planning and construction continued amidst political tension with the more arid Egypt downstream over possible future scenarios of reduced water shares for Sudan and Egypt. Funding for the dam came from domestic sponsorship, bond sales and tax revenue. Costing nearly US$4 billion, the project is Ethiopia's largest infrastructure investment. It is expected to take between 5 and 15 years to fully fill the dam reservoir (1,874 km^2) and saddle the dam (Kumagai 2016). This staggered filling was agreed upon between Sudan, Egypt and Ethiopia to reduce flooding and cater to downstream water needs. The GERD is expected to generate 6000 MW and benefit the energy-deficient 108 million population in Ethiopia and neighbouring Sudan. Once fully operational, the GERD could increase Ethiopia's electricity supply by as much as 150% (Champion and Manek 2019). Colonial treaties (Article III from the Anglo-Ethiopian treaty of 1902 and the 1959 Nile Waters Agreement)[12] between the United Kingdom, Italy, Ethiopia and Anglo-Egyptian Sudan gave the lower riparian countries more control over the Nile than Ethiopia. They apportioned the annual flow of the Nile between Sudan (25%) and Egypt (75%) only (Ullendorff 1967).

According to estimated land-cover changes from the European Space Agency (ESA) and Land Use and Land Cover (LULC) maps between 2000, 2010 and 2018, there was a slight increase in water bodies as construction neared completion between 2010 and 2018 (Figure 10). At the same time, there was a 5% decrease in shrubland and tree cover around the reservoir area. Reports predicted that reservoir filling would lead to a loss of 1,680 km^2 of land composed of 90% forests and woodland cover. Population datasets from LandScan and the NASA Socioeconomic Data and Applications Center (SEDAC) were used to estimate that between 1,985 and 4,421 people previously resided in the reservoir area in 2018 and were put at a high risk of displacement due to reservoir filling in 2020.

11 The Blue Nile, a tributary of the main Nile River, contributes 80% of flow to the Nile and originates from the source reservoir Lake Tana in the north-western Ethiopian highlands.

12 Ethiopia was not a signatory of the 1959 Nile Waters Agreement or the earlier more comprehensive version of the treaty from 1929.

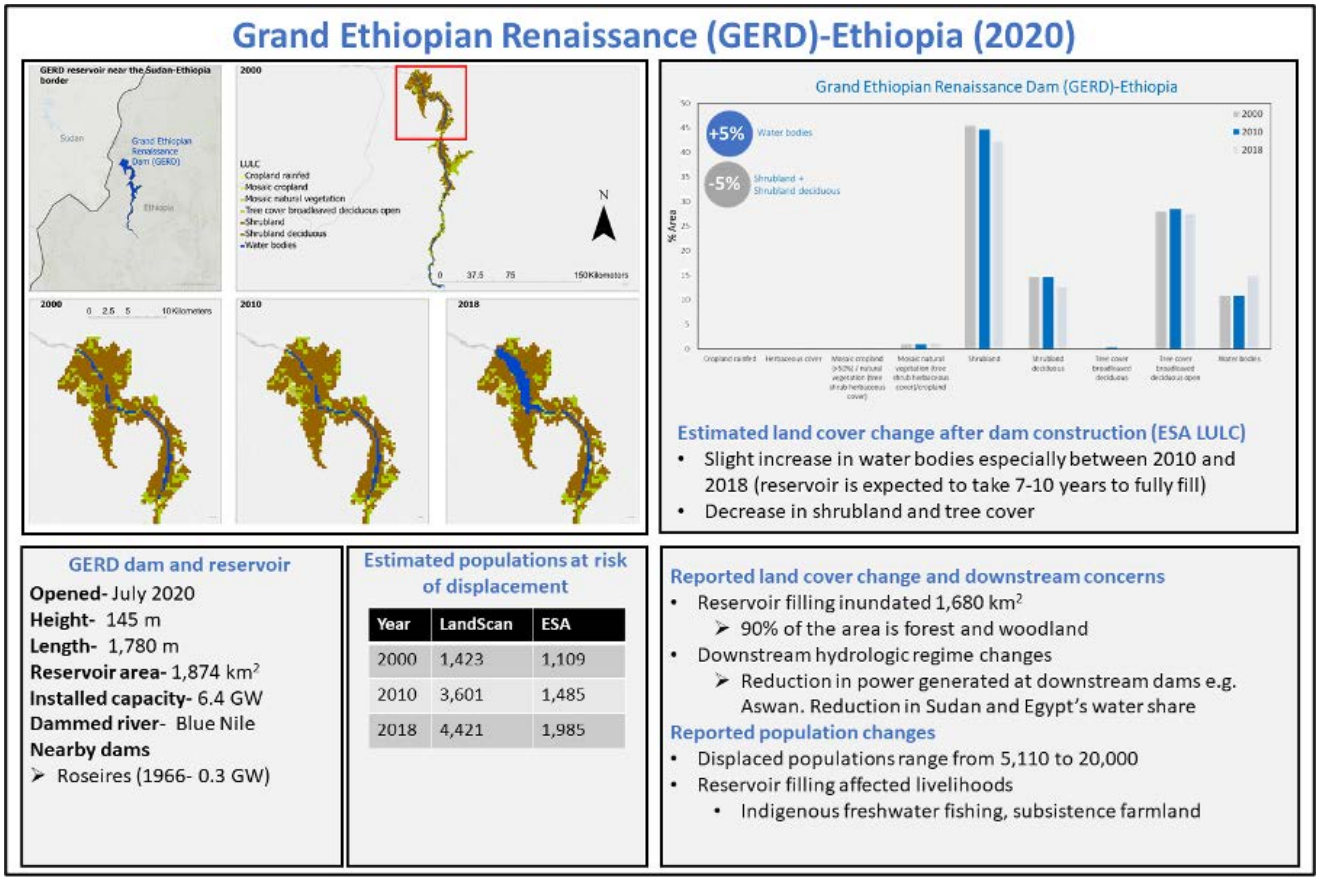

Figure 10. The recently completed Grand Ethiopian Renaissance Dam (2020) is expected to take five or more years to be fully filled. Reportedly, between 5,110 to 20,000 people may have already been displaced from the area. Reservoir filling is expected to affect the downstream riparian communities in Sudan and Egypt who depend on the Nile for irrigation and fishing

Reports estimate that displaced populations range from 5,110 to 20,000 (Ahmed and Elsanabary 2015). The affected population lives in the north-western state of Benishangul-Gumuz and depends on agriculture and traditional mining. Indigenous people of the area are the Berta, Komo, Mao, Shinasha and Gumuz, who farm inundated grazing fields and fertile land. Hunting and farming are expected to be severely affected. Most of those affected are from the Gumuz minority ethnic group. The Gumuz have previously been affected by the construction and filling of Roseires Dam (Veilleux 2013). Project management has been vague on resettlement plans for the affected populations. The region has a history of violent ethnic conflicts, and this forms a turbulent backdrop for resettlement projects (ibid.).

The filling of GERD's 74 billion m^3 reservoir is expected to reduce water flows downstream and impact the livelihoods of the relevant riparian communities in Sudan and Egypt. Model simulations have estimated a 2.8% decrease in water inflow to Egypt due to the presence of the GERD. Hydroelectric energy generation in dams downstream, like the High Aswan Dam (HAD) in Egypt, may also be impacted (with a 5.2% decline expected). Egypt's reliance on the Blue Nile for over 90% of its freshwater needs raises long-term concerns over water availability, as large dams like GERD are constructed along the Nile amidst growing populations across the East African region (Cascão 2009). The downstream regions may also suffer increases in soil salinity and saltwater intrusion, especially near the Nile Delta in Egypt. Higher salinity waters in Egypt and Ethiopia might reduce the availability of drinking water and affect soil productivity. Increasing rural electrification in Ethiopia is expected to reduce fuelwood demand and, in turn, decrease deforestation and erosion-induced soil degradation. Dams in the lower reaches like Merowe (Sudan) and High Aswan Dam (Egypt) may also benefit from reduced sedimentation load and increased infrastructure lifespan.[13] Additional benefits to GERD construction include drought and flood management in the lower and upper riparian regions. Water resource management facilitated by the dam is likely to be critical as climate change worsens water insecurity.

13 The Institute of World Politics (2020), Talk by Dr. Moges, https://www.youtube.com/watch?v=-afyuql69E0andt=3821s.

b. Three Gorges Dam - China (1994-2003)

The world's largest hydroelectric dam (with an installed capacity of 22.5 GW) is the Three Gorges Dam, which is built on the Yangtze, China's longest river. It was commissioned in 1994 and cost US$31.8 billion, which was well over the initial budget of US$8.3 billion (Gao 2007). A significant motivation for construction was electricity generation to support China's growing population and protect the immediate communities by intercepting and containing floodwaters from the Yangtze.

A 3% increase in water bodies and a 6% decrease in rain-fed, mosaic and irrigated croplands were estimated between 2000 and 2018 (Figure 11). Over the same period, surrounding grasslands and tree cover decreased. According to LandScan and SEDAC gridded population datasets in 2000, between 397,000 and 640,000 people from the inundated reservoir area were estimated to have been at risk of displacement. Both population datasets indicate a population decrease between 2000, 2010 and 2018, with LandScan showing a decrease in population of almost 50% between 2000 and 2018 (Figure 11).

When the 1,045 km^2 reservoir area was filled, it displaced 1.27 million people from 13 major cities, 140 towns and 326 submerged villages (Challman 2000). An estimated 80% of the people were moved to higher slopes, with a likelihood of low fertility soils, while the others were relocated to new settlements. The Yangtze River basin has significance in the historical and archaeological records of Chinese civilization. The Three Gorges area filled by the reservoir has a rich archaeological and cultural heritage from the Neolithic Daxi (ca. 5000-3200 B.C.E.) who had settlements in the area (Childs-Johnson 2000). In 2000 it was estimated that the area inundated by the Three Gorges reservoir contained at least 1,282 cultural heritage sites, including settlements and cemetery complexes (ibid). Salvage and preservation efforts led to the successful relocation of artefacts from the Zhang Fei Temple, which dates from 220-280 A.D. before the temple site was flooded (Sutton 2004).

The reservoir inundated 36 different vegetation types and 550 plant species (Su et al. 2013). Three years after dam impoundment, Su et al. (2013) found a significant decrease in terrestrial plant species and a change in forest composition from trees-shrubs to forbs-ferns domination, indicating a decline of long-lived terrestrial plant species. Reservoir filling increased regional seismicity and geohazards such as accelerated landslides and rock avalanches triggered by slope instability around the dam site (Song et al. 2018; Tang et al. 2019). Dam construction also interfered with the freshwater ecosystems of the Yangtze River, changing migratory patterns, spawning grounds and nutrient availability in the water column. Large structures like the Three Gorges Dam may also have contributed to the endangerment of species endemic to the Yangtze River waters, such as the white-flag dolphin and the Chinese paddlefish. Shifts in hydrological flushing of the river system due to changes in discharges may also increase salinity and the occurrence of harmful algal blooms. Despite these environmental disadvantages, the dam has also been estimated to have intercepted 18.2 billion cubic metres of potential floodwater, protecting many downstream cities and villages from flooding since it was constructed (Gan 2020). However, due to the geology and small reservoir area relative to the dam structure dimensions, the Three Gorges Dam's flood control capabilities might be minimal during severe floods (ibid.).

The world's largest hydroelectric dam (with an installed capacity of 22.5 GW) is the Three Gorges Dam, which is built on the Yangtze, China's longest river. It was commissioned in 1994 and cost US$31.8 billion [...] When the 1,045 km^2 reservoir area was filled, it displaced 1.27 million people from 13 major cities, 140 towns and 326 submerged villages

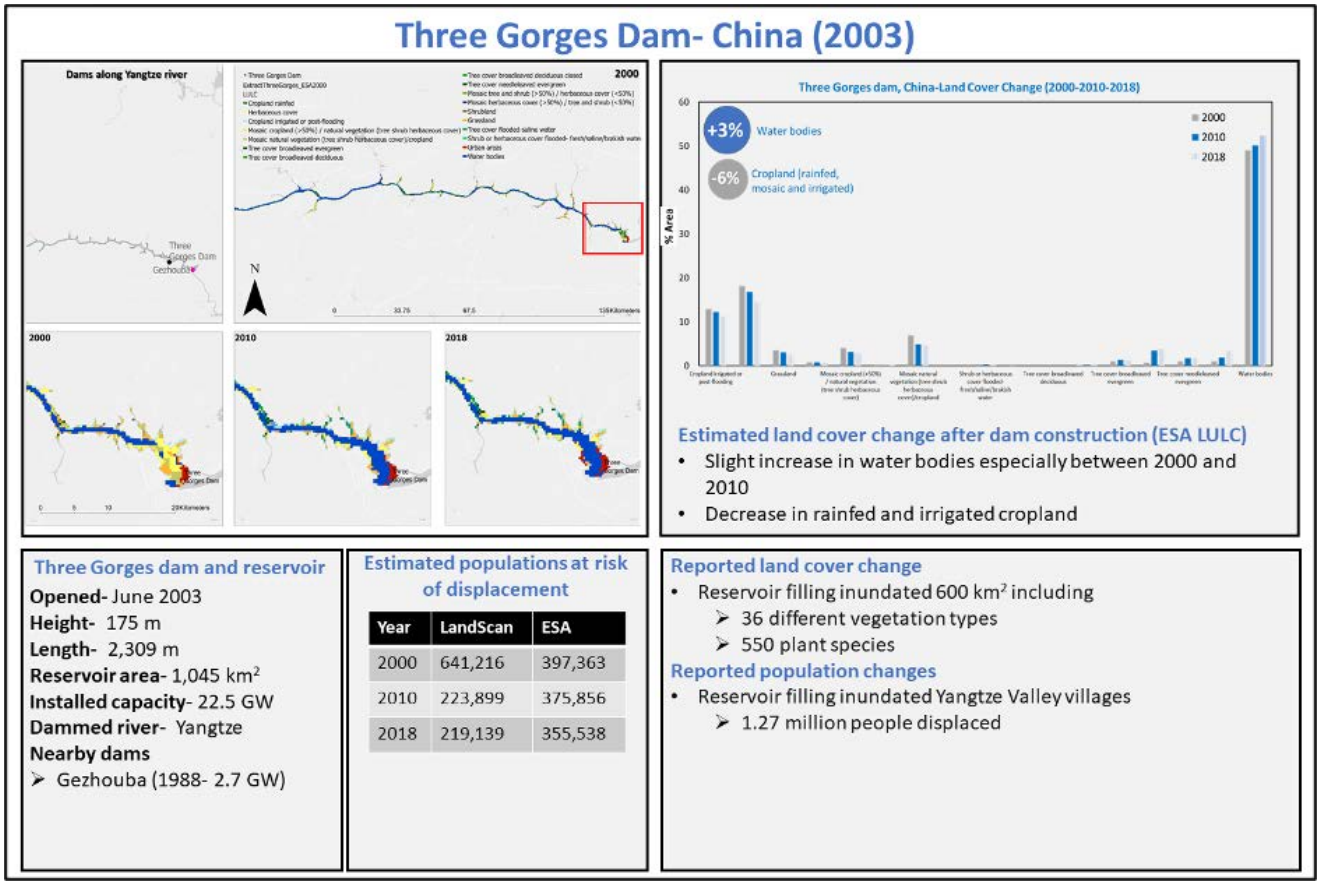

Figure 11. The Three Gorges Dam in China on the Yangtze River was completed in 2003 and is estimated to have displaced 1.27 million people from inundated Yangtze Valley villages. There was an estimated 6% decrease in cropland (rain-fed, mosaic and irrigated) between 2000 and 2018

c. Eastmain-1, Quebec - Canada (2006-2011)

In 2006, a 480 MW hydroelectric power station was commissioned on the Eastmain River in the boreal ecoregion of northern Quebec, Canada. The dam is part of the La Grande hydroelectric complex, a suite of dams and reservoir developments in the boreal environment of Quebec that dammed the Eastmain and the La Grande rivers before they emptied into James Bay. Eastmain-1 is managed by Hydro-Québec. Canada is the second largest hydroelectric producer in the world after China (2019). In 2002, the Cree communities indigenous to the area entered into a revenue-sharing agreement with the provincial government of Quebec detailing socioenvironmental and economic contributions of hydroelectric development projects to the immediate communities. The agreement gives the indigenous communities more control over their economy, increased employment opportunities with Hydro-Québec and cash payments for community developments.

This report estimates that there was a 73% increase in water bodies between 2000 and 2018 as the Eastmain reservoir was filled in 2011 (Figure 12). Dam completion and operation were accompanied by a 56% decrease in needle-leaved evergreen tree cover. Population datasets show that the reservoir area had no human occupation between 2000 and 2018. However, while the area was not permanently occupied, it might have served as a seasonal hotspot for the Cree's main livelihood activities of hunting, fishing and trapping – which traditionally required a large territory. The La Grande Complex affected the hunting grounds of four of the nine Cree communities around James Bay (Senécal and Égré 1999).

The Eastmain River flows through the territories of the indigenous Cree hunter communities that reside in northern Quebec. While reservoir filling did not result in significant human displacement, changes in the hydrology of the lake and river affected the livelihoods of Cree hunters, beaver trappers and fishers (Peloquin and Berkes 2009). Old hunting grounds were inundated, geese migration patterns changed and the lake sturgeon populations were affected by spawning locations downstream. While there are no reported cases of displacement or resettlement due to the

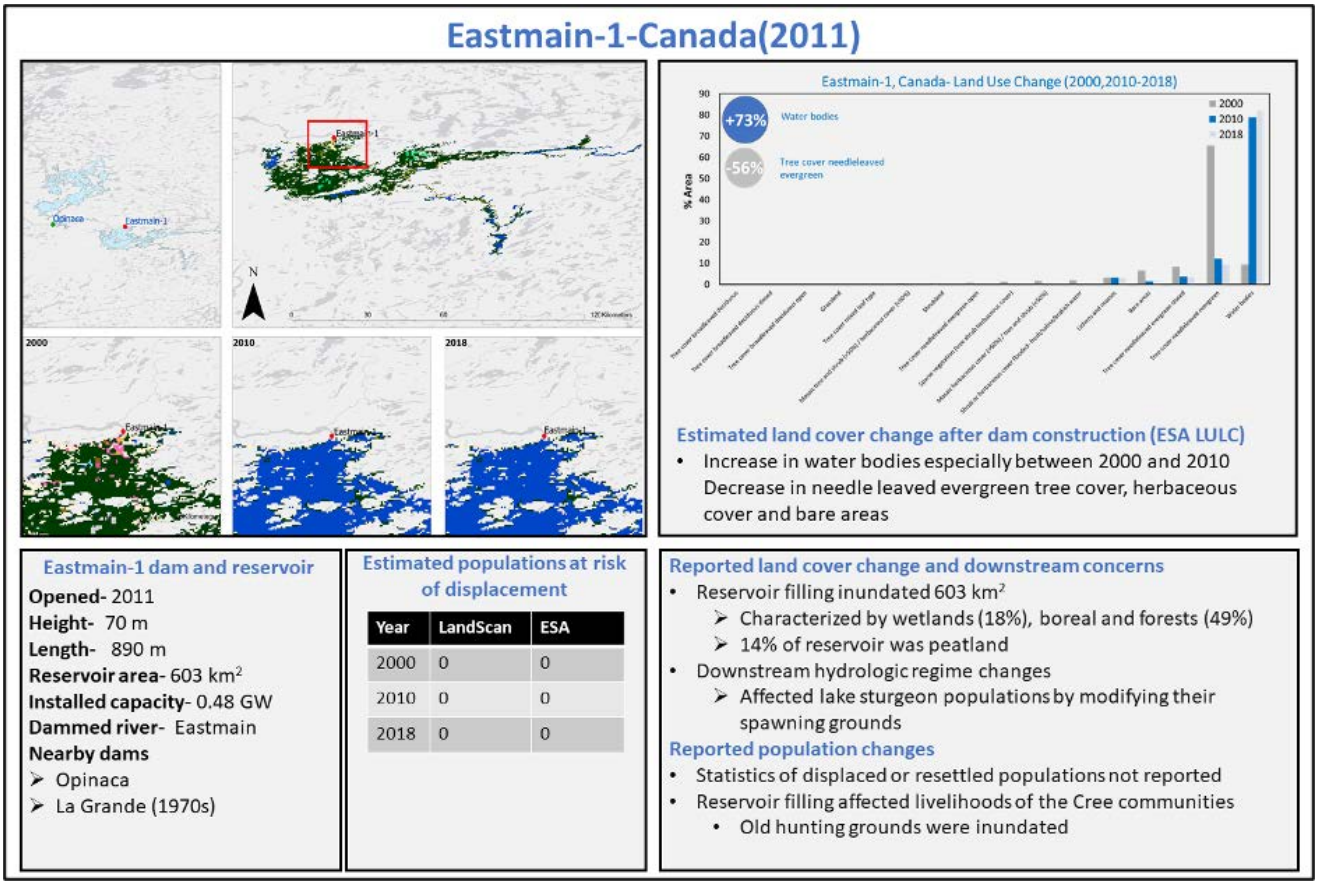

Figure 12. Although Eastmain-1 in Canada had no reported statistics of displaced or resettled populations, reservoir filling inundated 603 km² of wetlands, boreal areas, peatlands and forest.

construction and operation of Eastmain-1A, in other Hydro-Québec projects, Cree communities in Fort George were relocated to new villages in Chisasibi due to the La Grande project causing emotional and social distress (Radu et al. 2014). Moreover, hydroelectric power generation in the La Grande and Eastmain watersheds have affected the traditionally nomadic lifestyles of the indigenous groups amidst climate change challenges. Northern Quebec has significant hydroelectricity generation potential due to its geology and climate. However, initial damming projects in the 1970s were developed with little consultation with the indigenous Cree and Inuit communities. Today, Hydro-Québec has long-standing working relationships with the region's First Nations and they have worked together on community development programmes and ecological remediation following dam and reservoir projects.

Reservoir filling inundated peatlands and forests covering 14.65% of the land, plus lakes and rivers covering 21% of the flooded area (Bastien et al. 2011). The reservoir submerged up to 827 lakes with surface areas of between 100 m² and 10 km² (Tremblay et al. 2014). The site also had wetlands (bogs, swamps and marshes) and forest cover characterized by deciduous and coniferous trees. Lake sturgeon populations in the downstream region of the river were affected by changes in spawning grounds (ibid.).

Side box 3: Dam-induced displacement and resettlement

Christopher Schulz[14] *and Jamie Skinner*[15]

In 2000, the World Commission on Dams estimated the number of people displaced by dams at 40 to 80 million people globally, compiling secondary data from government sources and academic research. China and India are major dam-building nations, and they alone accounted for between 26 million and 58 million people within the global figures (1950-1990), with dam-induced displacement representing 34% of all development-induced displacement in China in that period (including displacement due to urban construction) (World Commission on Dams 2000). These estimates vary widely due to the difficulty in establishing who counts as a displaced person, as people displaced by supporting infrastructure are often overlooked. Residents without officially recognized land titles may also not be counted. The numbers of people displaced by dams are frequently disputed, with governments often providing much lower figures than non-governmental organizations (NGOs) (Kirchherr et al. 2019).

Twenty years after the World Commission on Dams, many social and environmental problems associated with large dams remain unresolved (Schulz and Adams 2019), while inadequate compensation and planning for resettlement following dam-induced displacement also remain key concerns (Hay et al. 2019). Future projections suggest that it will remain an important issue for decades to come, as many dams are being built for hydroelectric power production in Asia, Africa, Latin America and the Balkans. This is often carried out as part of a transition to renewable energy sources and to mitigate climate change, although the status of hydropower as a clean source of energy is disputed. This is because dam reservoirs, particularly in tropical countries, may turn into net sources of greenhouse gas emissions (Deemer et al. 2016). Zarfl et al. (2015) have estimated the number of hydropower dams under construction (17%) or planned (83%) at 3,700 globally.

The world's largest hydropower dam, the Three Gorges Dam on the Yangtze River in China with a capacity of 22,500 MW, was completed in 2009, but has displaced more than 1 million people, with some estimates for the final total reaching above 5 million people - according to official Chinese Government sources (Wilmsen et al. 2011). While other hydropower sites are less densely populated, resettling affected people and restoring their livelihoods remain significant challenges.

In many historical hydropower projects, dam-induced displacement and resettlement were an afterthought. A site was initially selected for its energy advantages, and an Environmental Impact Assessment was then designed to identify and mitigate impacts on people and ecosystems. This is changing as international lenders increasingly recognize that leaving resettlers worse off after a multi-million-dollar dam development is morally unjustified (see World Commission on Dams 2000). The most sustainable projects are now selecting sites in ways that reduce resettlement requirements from the outset, rather than optimizing energy outputs while assuming that the social impacts can be easily managed. Resettlement has thus become a factor influencing the initial decision-making process, rather than an impact to be managed.

The costs of "proper" resettlement continue to grow and there is little evidence to suggest that even these levels of investment are sufficient to re-establish lost livelihoods (Hay et al. 2019). Once a dam is constructed, the transformation in rural environments and social structures completely alters the landscape of natural and agricultural resources or employment opportunities available to local people. For some, the alternative is outmigration to urban slums.

Self-determined development pathways for these groups are therefore uncertain, and require sustained support from governments and donors alike if they are to be successful. One innovative approach is to share benefits from the revenue streams generated by hydropower with resettled people for the lifetime of the dam. This has the advantage of providing sustained, flexible funding over decades to support livelihood restoration investments for those affected, according to their own priorities (Skinner et al. 2014). Community priorities might range from local employment creation, increased investment in education and skills training to improved infrastructure.

In the end, "good" resettlement approaches displacement as an opportunity for development and engages all actors such as the State and

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the displacement industry (Wilmsen and Webber 2015). The literature evaluating the challenges of resettlement and post development-induced displacement has identified several factors pointing to a strong relationship between resettlement and impoverishment: the failure to estimate cost-benefits that properly reflect the social costs of resettlement; rigid resettlement planning that erodes human agency from affected communities; politics of inclusion and exclusion that might further exacerbate social inequalities; and unsatisfactory livelihood outcomes (ibid.).

Large hydropower projects will play an essential role in the low carbon energy transition, but this should not be at the expense of the well-being of rural communities. Given the general lack of success of the dam industry in properly re-establishing livelihoods following involuntary displacement, it is essential to reduce the resettlement footprint of the next generation of dams. Where resettlement proves unavoidable, benefits should be shared. Dam-affected people need to be the first beneficiaries of large dam development (World Commission on Dams 2000).

Large hydropower projects will play an essential role in the low carbon energy transition, but this should not be at the expense of the well-being of rural communities. Given the general lack of success of the dam industry in properly re-establishing livelihoods following involuntary displacement, it is essential to reduce the resettlement footprint of the next generation of dams

3.4 Environmental impacts of forced displacement and resource rushes

By the end of 2020, 82.4 million people had been forcibly displaced by conflict, war and persecution – the highest recorded number since 1990.[16] While approximately 78% of the world's refugees live in urban areas, the remaining 22% live in camps managed by the host country in conjunction with the United Nations High Commissioner for Refugees (UNHCR). Camps expand rapidly with refugee arrivals, and provide humanitarian relief, critical aid and essentials of food, water and shelter for refugees fleeing violence in their home countries. On average, refugee camps are established in sparsely populated regions within 50 km of the international border crossed by refugees (Van Den Hoek et al. 2018). As of 2018, the median residence within refugee camps was five years (Devictor 2019). Although designed to be temporary solutions, many refugee camps operate in a state of "permanent temporariness" - populated for years on end but still considered a short-term fix to forced displacement caused by violence and persecution (Abourahme and Hilal 2009).

Despite the tendency for host countries to locate camps in rural areas, UNHCR promotes cities as viable places for refugees to settle. The 2009 UNHCR Urban Refugee Policy recognized the high urban refugee population and their potential to attain socioeconomic independence with increased access to jobs and education.[17] In 2014, the recognition of urban refugees was supplemented by the Policy on Alternatives to Camps, which encouraged governments and humanitarian agencies to explore different ways of building refugee support systems other than encampments.[18] The policy made an additional case for seeking alternatives to camps, such as urban placement, in the light of resource pressures. In urban environments, existing electricity, water and employment opportunities could more efficiently accommodate increasing demand than isolated rural refugee camps.

16 UNHCR Global Trends Report, 2021, https://www.unhcr.org/flagship-reports/globaltrends/.

17 UNHCR, 2009. Policy on Refugee Protection and Solutions in Urban Areas.

18 UNHCR, 2014. Policy on Alternatives to Camps. https://www.unhcr.org/5422b8f09.pdf.

The 2018 Global Compact on Refugees (GCR) sought to support countries hosting many refugees through a call for international and equitable responsibility-sharing. However, the top-down approach of global migration governance like the GCR can be restricted by state governments and local social contracts that may evolve to address natural resource use and access. Asylum policies mandated by host countries affect: refugees' mobility beyond the camps, socioeconomic participation, land use and the likelihood of integrative resettlement. Asylum policies therefore set the tone for engagement and integration between local host communities and refugees. Host governments acting within their sovereignty may follow a so-called "closed" or "warehousing" model and wholly restrict refugees to the camp, thereby denying them access to local resources and reinforcing greater aid dependency. Alternatively, the host country may follow an open model and permit mobility beyond the camp for livelihoods, education, medical treatment and so forth, as well as allowing households to cultivate small pieces of land and harvest fuelwood. Irrespective of the host government's approach, encamped refugees almost always rely on humanitarian aid to re-establish their lives. When refugees are placed in well-designed camps and given access to land and economic participation opportunities, they can contribute to the local economy (Alix-Garcia et al. 2018). For example, Uganda's progressive model that gives refugees the right to work and freedom of movement is commended for increased integration between refugee and host communities, as well as self-sufficiency (Betts et al. 2019).

In some cases, mobility and socioeconomic restrictions on refugees result in increased local demands for fuelwood and drinking water. Environmental concerns associated with refugees' arrival and long-term presence in camps include deforestation and unsustainable water consumption. However, natural resource use around refugee camps must be assessed with due consideration for refugees' vulnerability in camps and their limited agency over livelihoods and land-use decision-making. Refugees are often left with no choice but to harvest fuelwood and clear land to establish a homestead, leaving a complicated and inconsistent picture of refugee-driven environmental degradation. Recent findings across all African refugee camps challenge the narrative that refugees are disproportionately destructive, after studies found increased conversion of forested areas into cropland near refugee camps (Maystadt et al. 2020). In Lebanon, a study predicted that rises in refugee populations could contribute to the increased likelihood of severe water stress (Jaafar et al. 2020). Previous studies have provided caveats of possible spillover effects of the increase in Syrian refugees moving to Jordan and a resulting indirect contribution to increased transboundary surface water flows (Müller et al. 2016). The implications of expanding refugee camps for surrounding natural resources include trade-offs between natural resources and livelihood improvement or increases in local production against a backdrop of rapid environmental change.

3.4.1 Case studies

Case studies involved analysis of refugee camps in Bangladesh, Uganda, Jordan and Colombia. These countries have recently received considerable refugee inflows driven by humanitarian and sociopolitical crises in neighbouring countries of Myanmar, South Sudan, Syria and the Bolivarian Republic of Venezuela, respectively. These countries were the origin (source) countries for two-thirds (13.6 million) of the global refugee population under UNHCR protection by the end of 2019.19 For each refugee-hosting country, place-specific environmental changes during periods of high refugee inflow were explored and contextualized in country-specific land-use policies, while short- and long-term land cover changes around selected refugee camps were also analysed. Open satellite data, UNHCR-designated camp locations, years of camp establishment and occupation, encamped refugee populations and camp planning boundaries were used to characterize the environmental impact of each camp.

a. Kutupalong-Balukhali refugee camp in Bangladesh (1992-present)

Cox's Bazar is a low-lying district on the south-eastern coast of Bangladesh that shares a border with the Rakhine state of Myanmar. The community has accommodated Muslim minority Rohingya fleeing violence and persecution in neighbouring Myanmar since at least 1977 (Alam 2019). Established in 1992, Kutupalong-Balukhali is the largest official refugee camp in Cox's Bazar (Figure 13). It is situated less than 20 km from the Bangladesh-Myanmar border and is one of the world's largest and fastest-growing refugee settlements: between early 2017 and late 2019, the camp population doubled from approximately 300,000 to 600,000 Rohingya refugees.

19 UNHCR, 2020. Mid-year Trends.

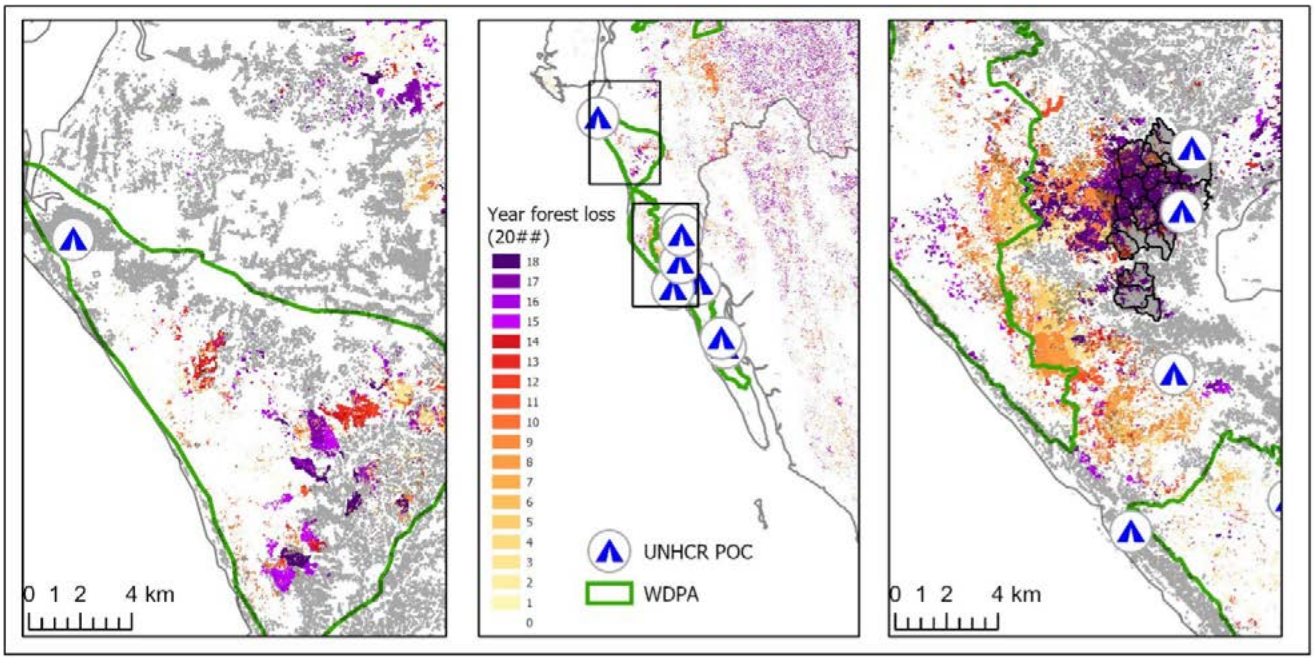


Figure 13. (A) Location of Kutupalong-Balukhali along with other camps in Cox's Bazar. The settlement footprint of refugee camps in Cox's Bazar (B) and Kutupalong-Balukhali Camp in 2019. Settlement footprint data are sourced from the Humanitarian Data Exchange (humdata.org). The maps focus on the border area between Bangladesh and Myanmar, showing some of the Rohingya refugee camps and deforestation in recent years; mapped using Google Earth Engine by Hansen et al. (2013). The grey areas in the bottom maps show buildings, as mapped by the Humanitarian OpenStreetMap Team. Green polygons show the extent of designated protected areas

Kutupalong-Balukhali and other Rohingya refugee camps in Cox's Bazar are particularly vulnerable to hazards such as landslides, flooding and erosion that are common during the monsoon season.

A 2018 report from the United Nations Development Programme (UNDP) on the environmental impacts of Rohingya refugee arrivals in Bangladesh estimated that 1,485 hectares of forest cover in Cox's Bazar had been cleared to make way for the refugee camps or harvested for fuelwood (Figure 13).[20] The same report highlighted increased risks of groundwater depletion and contamination, as well as encroachment into protected areas near the refugee camp. Other concerns include habitat fragmentation and endangerment of wildlife, given that camps are located near protected areas and that elephants roam nearby (Ashrafi 2020).

b. Bidibidi refugee camp in Uganda (2016-present)

Bidibidi is the largest refugee settlement in Uganda, with 270,000 refugees. The camp was established in 2016 during large-scale violence in South Sudan and is located only 40 km across the border into Uganda (Figure 14). Bidibidi lies on the communally held and managed land of the Aringa people, with whom refugees have an informal land agreement that provides access to land for agricultural production. The surrounding landscape is dominated by subsistence agriculture and is characterized by wooded grasslands and savannah.

Before the arrival of South Sudanese refugees, Bidibidi was a small village located nearly 500 km from the capital city of Kampala. Due to limited employment opportunities, 75% of Bidibidi residents are unemployed and dependent on subsistence agriculture. Under Uganda's self-reliance strategy for refugees, refugee households are allocated a 900 m^2 plot of land and given food and aid packages until they are deemed self-sufficient. Although Uganda has a more progressive refugee resettlement plan than other countries, there are concerns that refugees in Uganda are still not given the opportunity to choose where to settle and how best to support themselves.

20 UNDP Bangladesh and UN WOMEN Bangladesh 2018. Report on Environmental Impact of Rohingya Influx. Dhaka, Bangladesh.

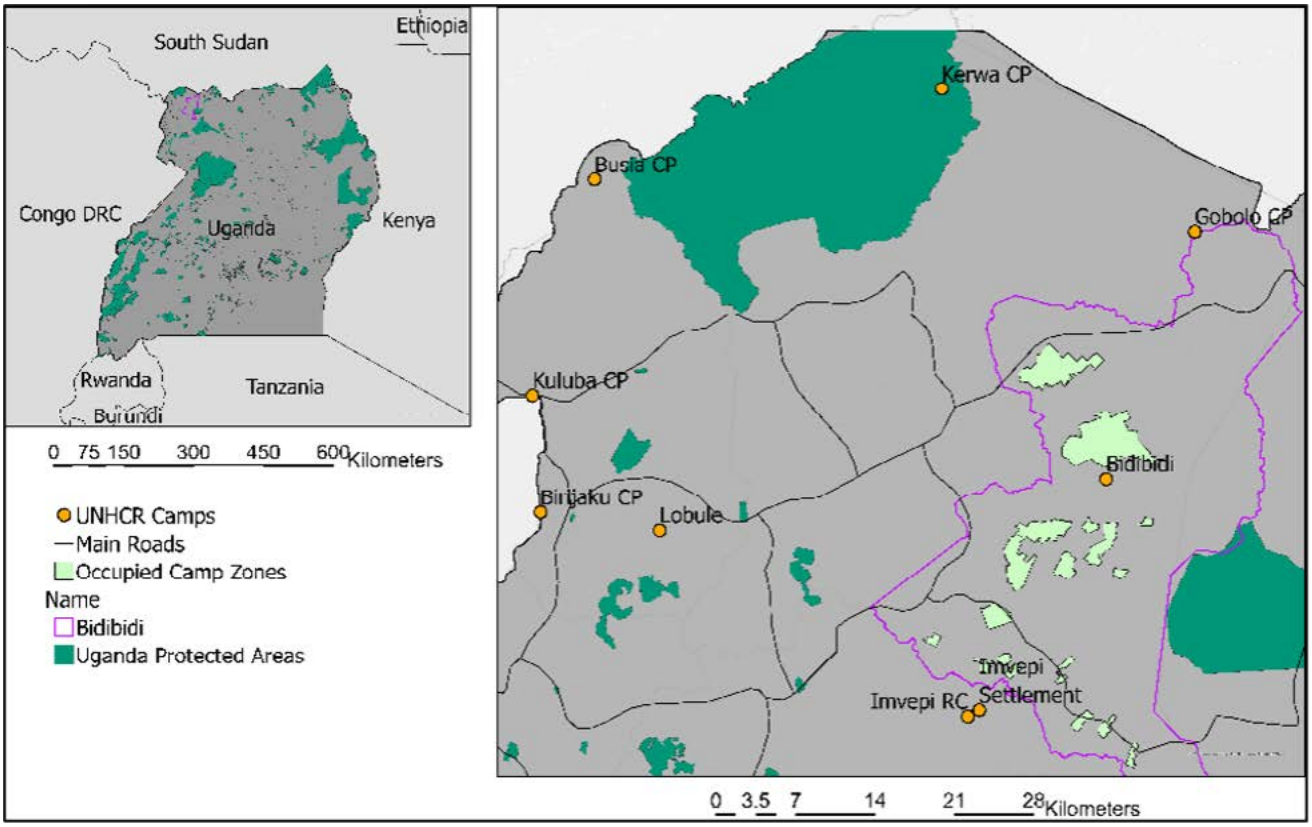


Figure 14. Bidibidi camp zone (light green) and location relative to protected areas (dark green), major roads and nearby Ugandan UNHCR camps such as Imvepi and Gobolo camps shown in orange.

Refugee and host community households use fuelwood daily to prepare meals, boil water and generate heat. According to a report by the Joint Environment Unit of the United Nations Environment Programme (UNEP) and the United Nations Office for the Coordination of Humanitarian Affairs (OCHA). , in the absence of comprehensive reforestation initiatives and provision of alternative energy sources, complete deforestation within the settlement is expected by 2022 (George and Dearden 2019). Fuelwood collection has become a contentious issue between refugee and host communities who all must travel further to gather fuelwood (Dawa 2018). However there is a promising collaboration involving host communities and refugees to carry out participatory mapping exercises that reveal the distribution of different fuel and medicinal plant harvesting patterns (see the humanitarian mapping project for Bidibidi using UNEP geospatial data platform-MAPX).

Bidibidi 's refugees also depend on groundwater collected through deep boreholes. At the end of 2017, the water needs of the camp's 285,969 refugees were met as follows: 30% from hand pumps, 43% from motorized pump systems and 27% from water trucks (Bassi et al. 2018). Bidibidi and the neighbouring Imvepi refugee camp administrators have been working to phase out the use of water trucks, which are costly for local groundwater sources. However, the Bidibidi resettlement is in a "low groundwater potential" zone, with a high risk of local aquifer depletion if boreholes are not well placed and managed (ibid.)

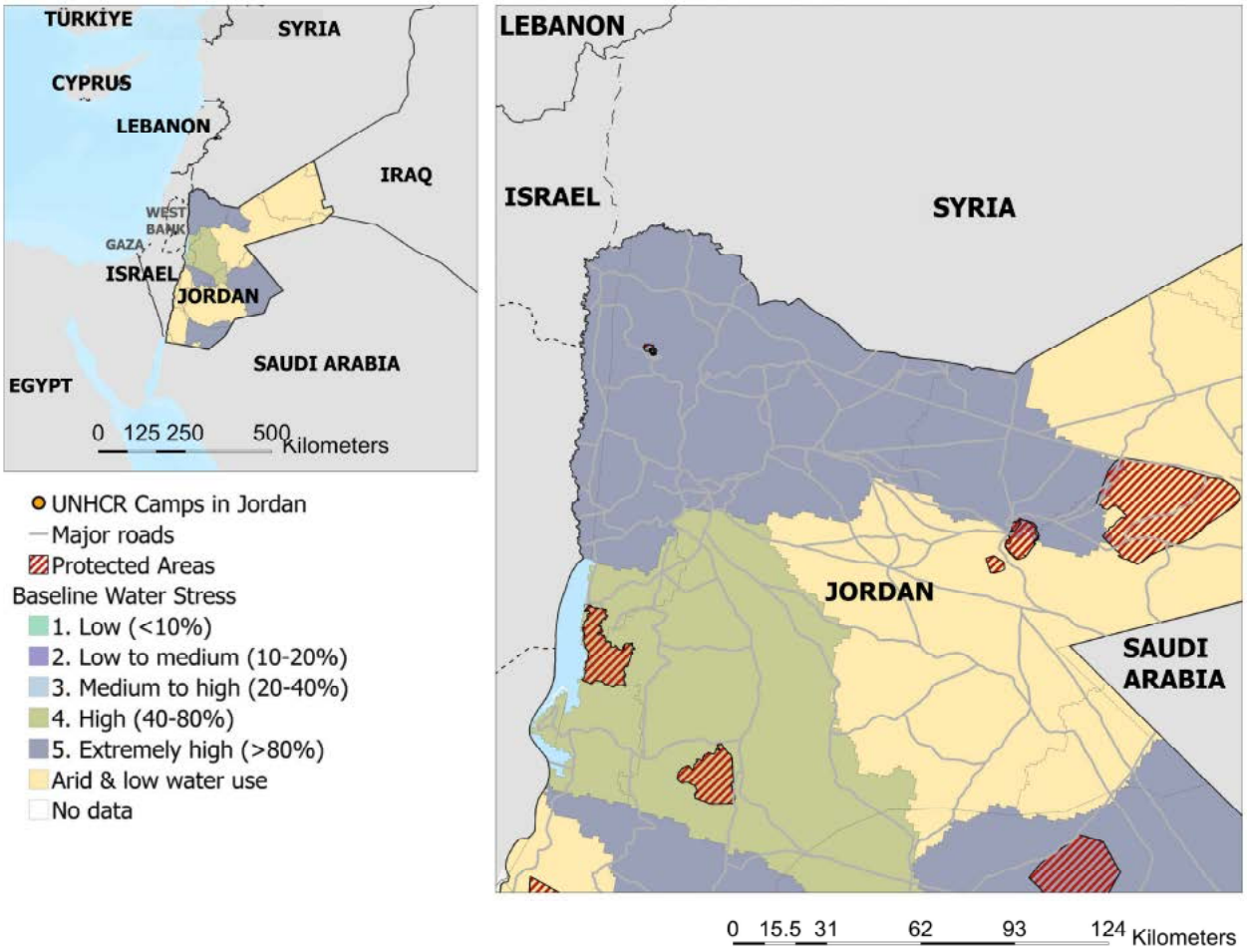


Figure 15. Location of Zaatari refugee camp and nearby dependence on groundwater resources for irrigation

c. Zaatari refugee camp in Jordan (2012-present)

Zaatari was established in July 2012 to accommodate a surge in Syrian refugees fleeing violence and oppression, and has been one of the world's largest Syrian refugee camps ever since. The Hashemite Kingdom of Jordan allocated 5.4 km^2 of unused land for the camp. It worked in partnership with UNHCR and 50 other UN agencies such as the United Nations Children's Fund (UNICEF) and the United Nations Population Fund (UNFPA) to prepare the camp in a matter of days. The camp is less than 16 km from the Syrian border and was initially designed to host approximately 22,000 people (Figure 15). By 2013, however, Zaatari housed over 200,000 Syrian refugees – making it the one of the largest refugee camps in the world. As of January 2021, UNHCR estimated that Zaatari was home to 78,800 refugees (with over 50% of inhabitants under 17 years old).

Mobility is limited, as refugees require a permit to leave the camp. Some camp residents compete for low-paying farm jobs with Pakistani and Egyptian immigrants in nearby groundwater-irrigated olive farms. These farms exploit the increased availability of low-wage labour provided by refugees (Al Naber and Molle 2017). The refugees who secure short-term employment in local farms are thus victims and are not responsible for the increased pressure on local water sources.

Zaatari is a desert camp in one of the world's most water-poor countries. Overall, Jordan extracts groundwater at twice the rate at which aquifers recharge (Whitman 2019). Drinking water is provided to Zaatari residents from the nearby Azraq and Zarqa groundwater reservoirs and routinely supplemented with bulk water trucking. In 2013, UNICEF trucked in 15.1 million litres of water per day to Zaatari (Ledwith 2014). With continued occupation amidst pervasive water scarcity, groundwater depletion is a major environmental concern in Zaatari and the surrounding region (Figure 15). Furthermore, climate change-induced aridity may exacerbate water scarcity in the area.

In 2012, electricity for street lighting in Zaatari was provided by the Jordanian government through the Irbid District Electricity Company. In 2017, an additional power supply to residents was made possible by the largest solar plant (12.9 megawatts) built in a refugee camp (Hashem 2017). The project provided employment opportunities, reduced risk from illegal grid connections and is a renewable energy source for the camp and the host community.

d. Maicao refugee crisis in Colombia (2014-present)

Unlike the cases discussed above of forced migration caused by conflicts and persecution, the influx of Venezuelans into Colombia has been driven by economic collapse connected to an overdependence on oil and worsened by a global health crisis. When oil prices crashed in 2014, the economy of the Bolivarian Republic of Venezuela was subjected to increases in national debts, hyperinflation and compromised democracy. By 2018, an estimated 87% of Venezuelan households were on or below the poverty line. This drove over 4.5 million people to leave their homes for Chile, Colombia and Brazil between 2014 and 2020 (UNHCR). Despite the driving factors of migration being different, the case of Venezuela highlights the lack of protection for economic migrants and illustrates the limitations of adopting binary categorizations of forced migration and economic migration.

Colombia currently hosts the largest number of displaced Venezuelans. The border between these two countries has been permeable due to historically friendly bilateral relations and sociocultural proximity (Roth 2019). In the border province of La Guajira, Venezuelan refugees now make up 20% of Maicao's population. Maicao is home to Colombia's first refugee assistance centre, which was set up in 2019. Although the host communities in Colombia-Venezuela border towns are actively involved in addressing the crisis, they operate with limited resources. The centre in Maicao has fewer amenities, smaller capacity (only 350 people) and supports much shorter stays (one month) than a traditional refugee camp.[21] As a result, many Venezuelans are housed as a result of grassroots responses led by local non-profits, families and churches.

Maicao is in one of the poorest provinces in Colombia, with high unemployment and poverty rates. The arrival of Venezuelan refugees has only exacerbated already declining socioeconomic conditions. Maicao is also resource-scarce, with high water and food insecurity due to its location in the middle Guajira drylands. Ecosystems are characterized by some grasslands, shrublands and agricultural activity. The province is prone to drought conditions triggered by El Niño shifts. In 2012 and 2016, drought conditions coincided with the rise in Venezuelan migrant populations in La Guajira, yet limited research has been carried out into the impact on natural resources.

3.4.2 The environmental impacts of resource-driven rushes and artisanal mining

Although estimates vary, there are estimated to be 100 million people directly and indirectly engaged in artisanal and small-scale mining (ASM) in over 80 countries (Jennings 1999). Most of these countries are low-income nations in Sub-Saharan Africa, South America, Oceania and Asia. In many of these countries, ASM is a long-established craft that predates European contact and colonialism. In the Akan region of Ghana, for instance, traditional gold mining was used for the kingdom of Akan (Ofosu-Mensah 2010). Today, ASM is estimated to account for 80% of global sapphire, 20% of gold mining and up to 20% of diamond extraction. This form of mining has become linked to global mineral commodity markets. This kind of extraction is heavily criticized for environmental degradation, linkages to smuggling, labour trafficking, money laundering and greater negative social and ecological externalities. Despite this, ASM has been established as a poverty-driven livelihood strategy that attracts a labour force willing to work under hazardous conditions to supplement low incomes. In developing countries, diminishing agricultural productivity and poverty have been identified as drivers that push the rural labour force into ASM (Hilson and Garforth 2012).

The environmental impact of ASM is associated with pollution and large-scale deforestation that turn productive and previously intact landscapes into wastelands. Gold mining using ASM is notoriously linked to mercury emission, with negative impacts on public health and food systems. An estimated one-third of all mercury emissions worldwide are generated by ASM (Telmer 2008). In the case studies below, we explore the environmental impacts of ASM gold mining in Tarkwa, Ghana and Peru (Madre de Dios) to highlight the impacts on land use. A literature review will then consider public health and river

21 UNHCR, 2019. UNHCR opens reception centre near Colombian border to assist vulnerable Venezuelans, https://www.unhcr.org/en-us/news/briefing.

pollution associated with heavy metal contamination from the mines. Alluvial gemstone mining as in Madagascar's sapphire rush towns attracts artisanal and small-scale miners. The geographic location of mineral and gemstone deposits close to protected lands and farmlands is noteworthy (see Figures 18 and 19 below) and illustrates potential land-use conflicts.

The environmental impacts of artisanal and small-scale mining at the local level of rush towns and intense mining activity are examined. A combination of land cover, satellite imagery and georeferenced datasets of mineral and gemstone deposits is used to map environmental change around gold rush towns in Peru and Ghana, large-scale gold mining activity in Papua New Guinea and sapphire rush towns in Madagascar. Changes in night-time lights activity (Levin et al. 2020) are examined to highlight changes in economic activity, development and population associated with the expansion of mining (despite the fact that night-time light activity may not provide sufficient information on specific migrant groups such as ASM miners) (Kyba et al. 2019).

Case studies are organized by contextualizing resource extraction in historical trends and drivers and then examining the environmental setting with a focus on biodiversity and ecosystem services. The third and fourth cases assess the social and ecological impacts of ASM in rush towns, emphasizing changes in forest cover, pollution externalities on rivers, soils and public health. While the net environmental impacts of ASM indicate a destructive industry, socioeconomic outcomes in terms of employment opportunities and higher income streams suggest positive links to poverty reduction and improved livelihoods. Case studies therefore also consider the positive outcomes of ASM.

a. Sapphire rushes in Ilakaka, Madagascar

The alluvial deposits of Ilakaka in southern Madagascar are among the largest reserves of high-quality sapphire in the world (Figure 16a). Madagascar accounted for about 50% of the world's sapphires in 2002 and continues to maintain that share as the world's leading producer of sapphire (Shigley et al. 2010). Sapphires are used for jewellery production and can be used industrially in solar cells and semiconductors. The gems tend to be small. This makes extraction and sorting difficult and increases the likelihood of their being smuggled across borders (Ferry et al. 2020). An estimated US$100 billion to 200 billion is lost every year to smuggling. Many Malagasy-sourced sapphires enter the global market through Thailand and Sri Lanka, where polishing and cutting are carried out.

Alluvial gemstones like sapphire are well suited to small-scale and artisanal mining. This is because extraction is easier than with metallic mineral deposits, which tend to lie deeper, and the ASM market for such stones has low barriers to entry. Easy mining and informal markets drove the rapid population increase of Ilakaka following the discovery of sapphires in the late 1990s. Between 1998 and 2000, the town's population grew from 30,000 to 100,000 as it attracted many migrant miners from northern Madagascar where earlier rushes were slowing down (Laurs 2003). In 2019, an estimated 112,500 migrants still lived in the mining district of Ilakaka-Sakaraha (Canavesio and Pardieu 2019). In the last 22 years (1998-2020), Madagascar has had several gem rushes of artisanal miners moving between districts and cities attracted by new sapphire deposits. However, most of these movements are poorly documented.

Madagascar is one of the most ecologically diverse regions globally, with 25% of the world's primates and 4% of the world's plants, many of which are endemic to the island and endangered (according to WWF). Artisanal gemstone mining activity is carried out near protected lands, critical ecosystems and conservation reserves with potential encroachment and degradation risks (Figure 16b) (Cardiff and Andriamanalina 2007). In Ilakaka, mining takes place along the river, 14 km away from the National Park of Isalo. Surface and subsurface blue sapphire mining have been linked to environmental problems including deforestation, gully erosion and sedimentation of rivers and streams due to gemstone washing. The extraction of gemstones from secondary alluvial terraces might also compromise slopes and permanently scar the landscape due to trenching and hole digging. However, there has been minimal habitat damage in land cover due to limited forest cover as grassland savannahs dominate the area (Cook and Healy 2012). The town of Ilakaka has expanded alongside increased mining activity in the area. Satellite imagery from between 1997 and 2021 shows increases in built-up areas along the river as outlined in black in Figure 16c-e. At the same time, there has been an increase in mining activity on the eastern side of town, as outlined in red in Figure 16f, (based on satellite imagery captured in 2021).

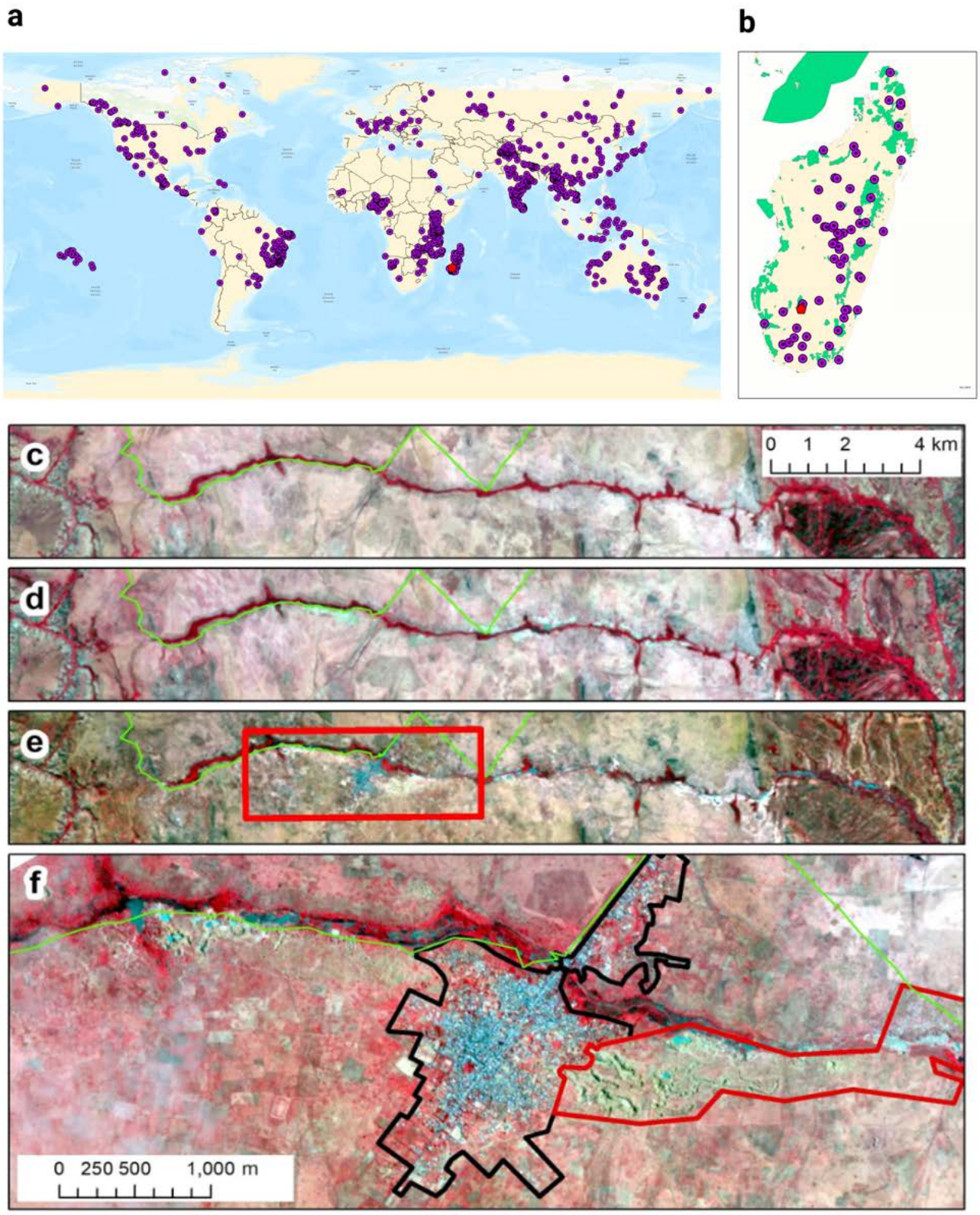


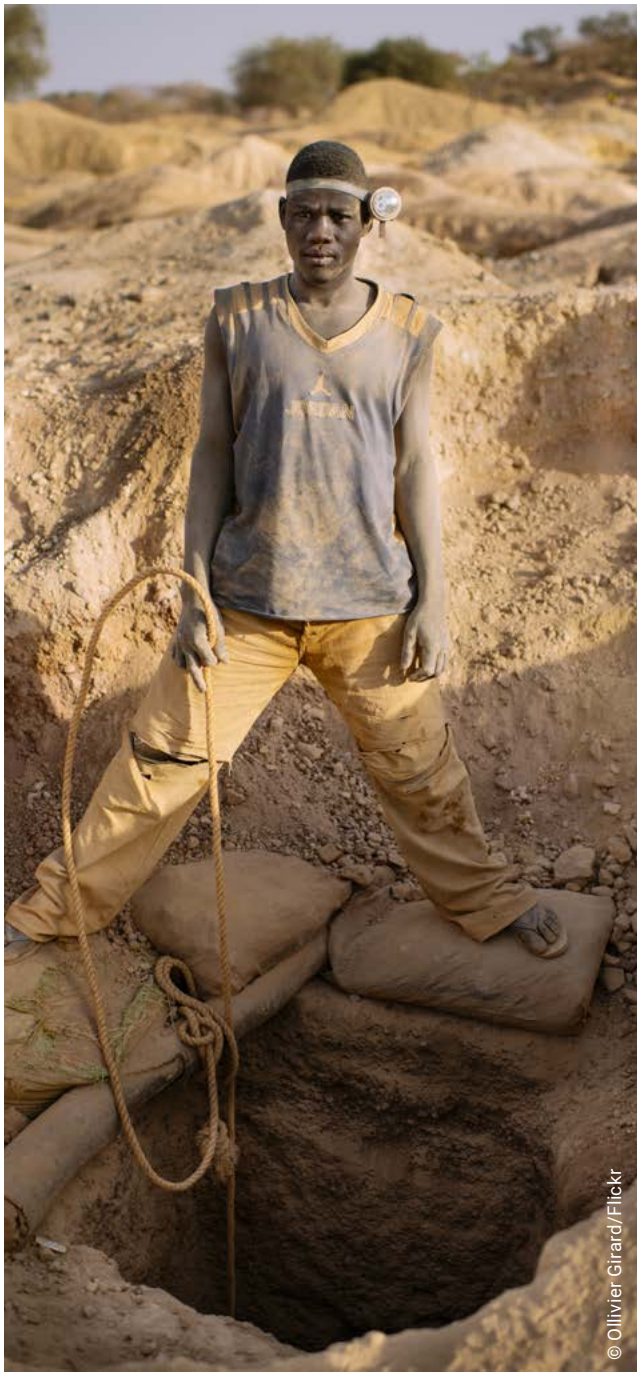
Figure 16. (a) Global distribution of gem mining (purple circles; Flöter et al. 2007); (b) Gem mining in Madagascar (protected areas shown in green); the location of Ilakaka is shown by a small red point in the south of Madagascar; (c) Landsat image, 11 January 1997, Ilakaka River, before the beginning of mining; (d) Landsat image, 8 February 1999, Ilakaka River; note the starting of mining operations along the river; (e) Landsat image, 2 May 2020, Ilakaka River; (f) Planet Labs image, 23 January 2021, Ilakaka. The black denotes the residential area, and the red polygon marks parts of the mining area, as mapped on OpenStreetMap. The green line indicates protected areas. All satellite images as false composite images, red hues indicate green vegetation. 8 February 1999, Ilakaka River

b. Gold mining rushes in Tarkwa, Ghana

Ghana was known as the Gold Coast prior to its independence in 1957. In 2018, Ghana overtook South Africa as Africa's largest producer of gold (Botchwey and Crawford 2019). Artisanal and small-scale mining accounted for 35% of Ghana's total gold production in 2014 and produced almost 1.5 million ounces of gold, while supporting an estimated one million people with employment opportunities. Participation in small-scale mining is poverty driven and attracts a range of low-skilled men, women and young people seeking to supplement low incomes. However, gold mining operations have brought negative environmental and socioeconomic impacts despite the sector's contribution to labour and poverty reduction. Artisanal mining operations can become poverty and pollution traps.

Wassa West District (WWD) in south-west Ghana is the country's oldest and most intensively mined district due to its rich gold deposits (Figure 17a-b). The district is categorized under the Eastern Guinean Forest ecoregion dominated by evergreen rainforest vegetation. Gold mining activity in WWD is concentrated around Tarkwa, the largest and oldest mining concession (11,400 ha), and mining occurs at two different scales. It can be small-scale, with artisanal miners, traditionally referred to as the galamsey, accessing gold through hand-dug pits or river panning. On the other hand, there is large-scale mining operated by companies with ties to international market and leases granting them access to large tracts of land. Goldfields Ltd operates the Tarkwa concession.

Mining concessions in WWD and Tarkwa near farmlands and protected areas have complicated land-use issues and trade-offs related to likely encroachment from competing users (Figures 19 e and f). As shown below, the expansion of Tarkwa mining between 1986-2020 shows newer built areas approaching the borders of protected areas (Figure 17 g-h). Large-scale surface mining removes primary vegetation and topsoil critical for agriculture. As a result of digging and washing, rivers often become polluted by sediment and mercury from artisanal mining activity. Artisanal mining activity is estimated to release 5 tonnes of toxic mercury emissions every year. Miners also face an occupational hazards through exposure to this carcinogen. For instance, small-scale Ghanaian miners in Tarkwa and Accra have been identified as overexposed to mercury (Hilson 2002). Large-scale mining can displace people from their land, jeopardize livelihoods or force household members to seek alternative income streams. Artisanal and small-scale mining is one example of a sector with low barriers to entry. This is problematic because it homogenizes land use towards extraction, bare earth and built-up environments. Tying the local and national economy to mineral extraction can intensify environmental degradation and expose livelihoods to economic downturns. Moreover, mines (large-scale and artisanal) might increase wages, siphon off labour from rural farmlands and cause a decline in agricultural productivity.



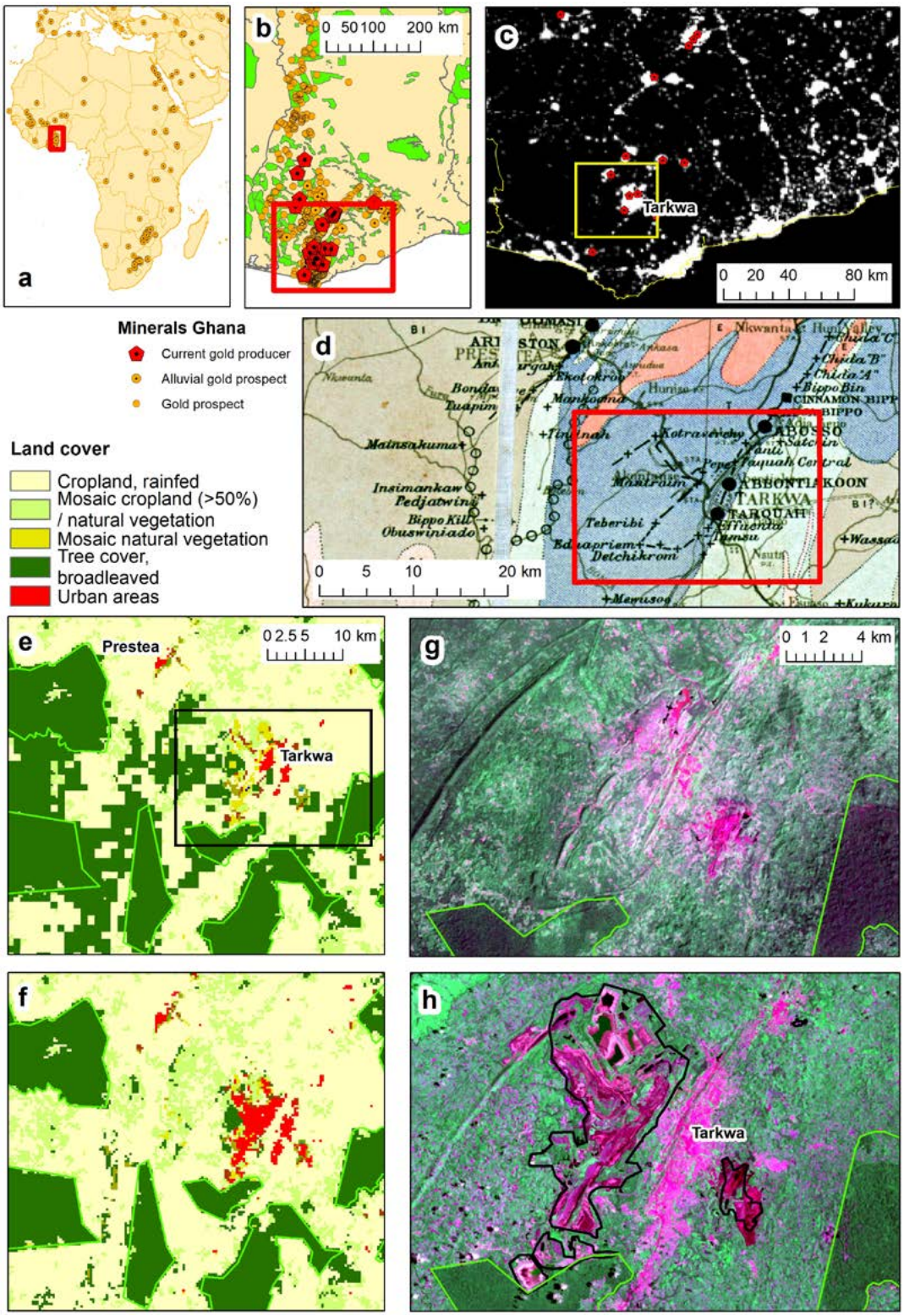


Figure 17. (a) Distribution of gold deposits in Africa (orange circles; Tollefsen 2012); (b) gold prospecting and mining in Ghana; (c) VIIRS/DNB night-time lights of Ghana, as of 2016; note that gold mine production areas are brightly lit; (d) 1934 geologic map of Ghana (source: Basel Mission Archives, BMA 96170, Title: "Geological Map of the Gold Coast. Southern Sheet. Showing Positions of Gold Mines and Prospects"; https://www.bmarchives.org/items/show/100203728), showing some of the communities resettled following the establishment of the Tarkwa gold mine in the 1990s; (e) European Space Agency mapping of land cover, as of 1992, with an overlay of protected areas (green polygons); (f) European Space Agency mapping of land cover, as of 2018, with an overlay of protected areas (green polygons); note the reduction in forest cover, and the expansion of the built areas around Tarkwa; (g) Landsat image (false colour composite of bands 7, 4 and 5; areas in magenta correspond with built-up areas and mining areas), 29 December 1986, Ghana, before the beginning of large scale gold mining operations; (h) Landsat image, 29 March 2020, Ghana, note the large extent of gold mining operations.

c. Lihir gold mining and the resettlement of Putput communities

The Lihir islands are in Papua New Guinea, off the coast of mainland New Ireland (Figure 18a and b). The largest of the six Lihirian islands, Aniolam is home to one of the world's largest gold mines and deposits. Gold exploration on the eastern regions of Aniolam island started in 1995, with mining beginning in 1997 (Bainton 2010). Mining operations were initially financed and led by the British-owned Rio Tinto Zinc Corporation (RTZ) and are operated by Newcrest Mining. Mining is expected to continue until at least 2040.

Mining led to the relocation of two coastal settlements, Putput and Kapit. A new village called Putput 1 and later extended to Putput 2 was established on the south-eastern fringe of the island after 215 people were relocated into newly constructed homes. Displaced villagers received compensation for losing land, gardens, homes, sacred sites and gravesites. Tension arose due to the relocation process and compensation distribution: landowners were the sole direct claimants to the compensation packages despite the traditionally complex Lihirian land tenure system. Before resettlement, Putput residents were subsistence farmers who supplemented their livelihoods with fishing. Compensation packages rapidly elevated households in mining lease regions into the middle class, turning Putput into a suburban coastal settlement. Mining led to the relocation of two coastal settlements, Putput and Kapit. A new village called Putput 1 and later extended to Putput 2 was established on the south-eastern fringe of the island after 215 people were relocated into newly constructed homes. Displaced villagers received compensation for losing land, gardens, homes, sacred sites and gravesites. Tension arose due to the relocation process and compensation distribution: landowners were the sole direct claimants to the compensation packages despite the traditionally complex Lihirian land tenure system. Before resettlement, Putput residents were subsistence farmers who supplemented their livelihoods with fishing. Compensation packages rapidly elevated households in mining lease regions into the middle class, turning Putput into a suburban coastal settlement.

In 1995, the Lihirian population was estimated to be 9,892. By 2007 the population had reached 13,844, with a growing number of non-Lihirian migrant labourers and returnees. In-migration from nearby islands and other parts of Papua New Guinea increased as job opportunities arose in the mines and the local economy grew as a result of mining activity. Mining projects financed roads, public health facilities, local airstrips and schools. However, benefits seem to be concentrated to the island's eastern coast, where road networks visibly connect Putput, the mining site, the airstrip and other facilities.

Like other island complexes in the Pacific Ocean, the Lihir islands are tropical biodiversity hotspots and, at least on paper, the entire area of Aniolam Island was designated as a protected area in 1991. Papua New Guinea sustains 6% to 7% of the world's species in less than 0.5% of the land (Shearman and Bryan 2015). Communities rely on coastal mangrove systems to mitigate flooding and use forest resources for constructing houses and canoes. Beyond that, natural resources are linked to local cosmological beliefs. An illustrative example of how mining activity has threatened to disrupt traditions is the location of the Ailaya rock within the Putput mining plant. The Ailaya is a sacred section of the caldera central to the burial traditions of Lihirian tribes that remains conspicuously forested amidst mining activity due to an agreement to preserve it.

The environmental footprint of gold mining in Lihir has increased in step with mining progress between 1997 and the present (Figure 18 e-g). Decreases in forest cover, increases in bare soil and turbidity plumes into the waters surrounding the mining site are visible on the map below. Submarine waste disposal of rock and tailings from the mine has also been a cause for concern. There is continuous deep-ocean disposal of 9-24 Mt/year of mining waste (Thomas et al. 2003). Tailings carry high concentrations of heavy metals, which change the pH and impair the water quality of nearby coral reef environments. Waste rock increases turbidity in reef waters, with detrimental effects on coral cover, biodiversity and fish communities.

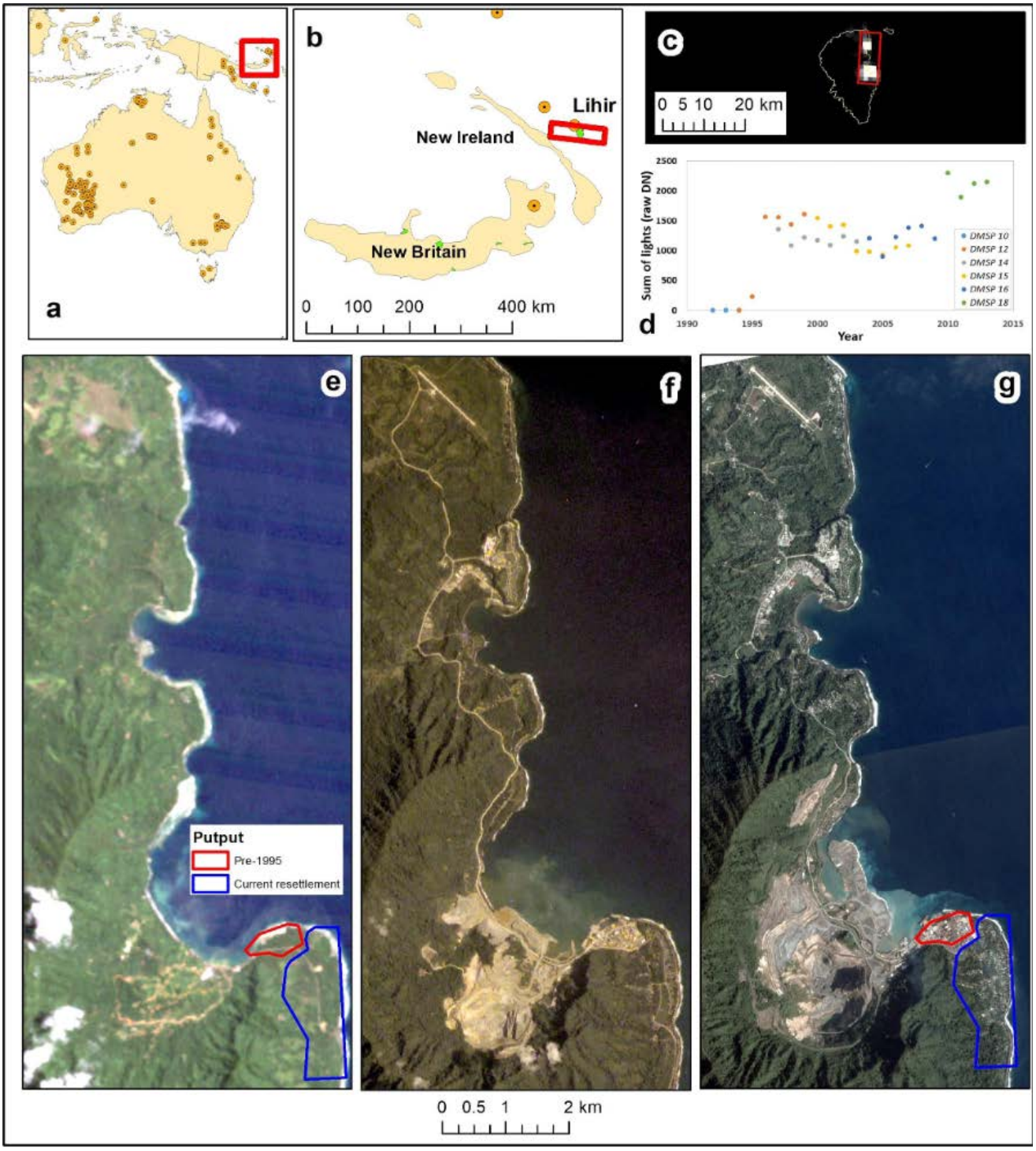


Figure 18. (a) Distribution of gold deposits in Australia and Papua New Guinea (orange circles; Tollefsen 2012); (b) gold deposits in the eastern islands of Papua New Guinea; the location of Lihir Island is shown by a small red point; (c) VIIRS/DNB night-time lights of Lihir Island, as of 2016; (d) Sum of lights (raw DN values from DMSP/OLS) for Lihir Island; (e) Landsat image, 28 March 1989, Lihir Island, before the beginning of gold mining operations; (f) Astronaut photo (ISS001-E-5933) from the International Space Station, 28 January 2001, Lihir Island; (g) Planet Labs image, 15 January 2021, Lihir Island. The red polygon denotes the location of Putput village before 1995 (based on Owen and Kemp, 2015), and the blue polygon denotes the current resettlement of Putput village. Note the expansion of the mining area with time, and additional facilities constructed both on land and at sea.

d. Gold mining rushes in Madre de Dios, Peru

In Madre de Dios Province, artisanal gold miners pan for gold in the Peruvian Amazon – another one of the world's ecologically diverse hotspots. In 1998, Peru's Ministry of Energy and Mines estimated that Madre de Dios generated about 70% of the country's artisanal gold production. The ASM sector also provides direct employment to as many as 30,000 miners, which is probably a major underestimate due to the high rates of unapproved mining operations. At the same time, mining activity contributes to deforestation and river pollution with heavy metals (Gardner 2012; Asner et al. 2013). This type of mining is concentrated along the Madre de Dios River and its tributaries. Mining in the region can take the form of excavation (which requires heavy machinery) or suction pumping and water cannons (often in use around rivers and small lakes). Both forms stress the landscape, intensify deforestation and increase sedimentation and erosion rates in rivers.

The dominant vegetation in the area is tropical lowland rainforests with high biodiversity. A single hectare in the Peruvian Amazon is home to 300 tree species and much more endemic flora and fauna in the forest canopy and soils (Phillips et al. 2003). Other than the rich biodiversity, the Madre de Dios basin is home to indigenous southern Amazonia groups such as the Huachipaire, Arasaeri and other Harakbut communities that have occupied the reaches of Madre de Dios since pre-Colombian times (Federación Nativa del Río Madre de Dios y Afluentes - FENAMAD). Gold mining using ASM has emerged as more of a threat to Peruvian tropical forests than agriculture and logging (Alvarez-Berríos and Aide 2015). Between 2006 and 2009, an estimated 1,915 ha/year of forest cover was lost to mining activity in the region, outpacing nearby settlement deforestation (Swenson et al. 2011).

Increased mining activity in the region has been positively correlated with rising mercury importation to Peru to aid the gold-extraction process (as well as the resulting mercury pollution in the air and waters of Madre de Dios) (Ashe 2012). An estimated 30 to 40 metric tonnes of mercury are dumped into the rivers of Madre de Dios. Overexposure to mercury has tremendous impacts on the health of small-scale gold miners and Madre de Dios is no exception. A previous case study examining gold mining in Ghana noted the same occupational hazard. The pollution externalities of small-scale mining processes that use mercury as an input extend into the ecosystem: fish become highly concentrated with mercury, and this eventually makes it into people's diets.

Landsat imagery, georeferenced datasets of gold deposits and Day Night Band (DNB) from the Visible Infrared Imaging Radiometer Suite (VIIRS) showing lights overlaid by deforestation estimated from Hansen Forest cover were used to map environmental changes linked to ASM gold mining activity around Madre de Dios. In two sections that lie on the tributaries of Madre de Dios (Figure 19 c), significant forest clearance and dugouts were observed between 1986 and 2019. In 1986, before the ASM gold rush, Landsat imagery showed intact forest cover (Figure 19 d-e). Thirty years later, satellite imagery shows a scarred landscape due to suction and digging of gold along the tributaries (Figure 19 f-g). Forest cover is absent or patchy in regions with high levels of mining activity.

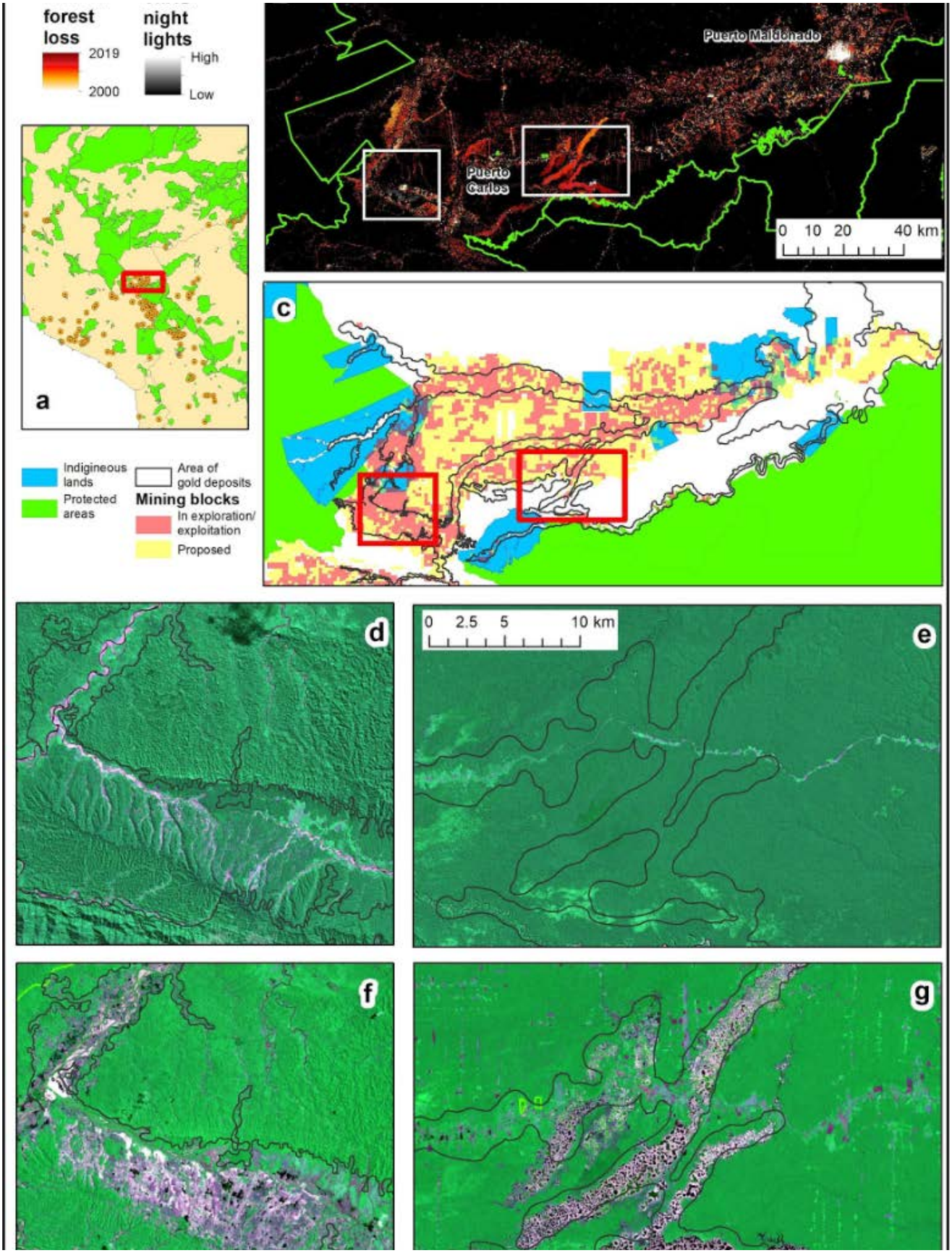


Figure 19. Distribution of gold deposits in Peru (orange circles; Tollefsen 2012); (b) VIIRS/DNB night-time lights in the region of Madre de Dios, as of 2016 in the background, overlaid by deforestation, based on Hansen et al. (2013); (c) Gold mining areas (Source: RAISG, The Amazon Geo-Referenced Socio-Environmental Information Network); (d) and (e) Landsat image (false colour composite of bands 7, 4 and 5), 12 July 1986 ; (f) and (g) Landsat image (false colour composite of bands 7, 4 and 5), 25 September 2019.

Side box 4: The role of water availability in climate mobility decisions in Peru

Pablo Escribano (IOM) and Jonas Bergmann (PIK)

The Potsdam Institute for Climate Change Research (PIK) and IOM have partnered to produce a report that assesses evidence on the nexus between mobility and climate change in Peru (Bergmann et al. 2021). Based on a systematic literature review, the report identifies major hazards that affect populations in Peru's three major topographic areas (the coast, the highlands and the Amazon rainforest); the variety of coping and adaptation mechanisms employed; and the role of migration in these responses.

Decreases in water availability appear as a key challenge for local livelihoods that has a demonstrated impact in driving population movements in different scenarios (Bergmann et al. 2020). Poor rural smallholders across the country are often affected by hazards that decrease the availability of much-needed water resources to support their livelihoods. Various factors reduce access to water including meteorological drought (National Meteorology and Hydrology Service of Peru [SENAMHI] 2019) and accelerating glacier recession, which has destroyed approximately 40% of Peru's glacier surface area since 1962 (Institute for Research on Glaciers and Mountain Ecosystems of Peru [INAIGEM] 2018).

Most of Peru's population resides in arid areas where desertification is a major concern (Peruvian Ministry of Environment 2016). While populations implement a set of traditional adaptation measures to cope with water stress, these options become increasingly ineffective when access to fresh water critically diminishes (Bergmann et al. 2020). Risk analyses developed by national authorities predict critical conditions for crops and/or livestock in different regions of the country (National Plan for Disaster Risk Management of Peru [PLANAGERD] 2014).

When water availability is reduced through rainfall changes or glacier retreat, studies show mobility as a coping measure in the coastal and highland regions of Peru (Áncash, Junín and Piura) (Bergmann et al. 2020). However, movement is not the first or only coping and adaptation measure adopted by households in response to water scarcity (Koubi et al. 2016). Studies show that respondents also request assistance from friends/family, reduce expenses, carry out extra work or sell livestock (Bergmann et al. 2021). Many other people lack options to react (Oft 2009; Oft et al. 2010).

Any hazard-driven mobility in Peru is part of strong, pre-existing systems. For example, migration is considered an essential part of the social fabric of the highlands, and some villages have one or several migrants in virtually every household (Cavagnoud 2018). Transhumance is an inherent feature of community life (Cometti 2018). When hazards hit, mobility options are shaped by vulnerabilities and the availability of resources at the household level.

Many factors influence vulnerability, including geographical location. For example, pastoralists at high altitude often lack diversification options, thereby increasing their vulnerability (Heikkinen 2017). If such pastoralists do move, migration can be more permanent (Milan and Ho 2014). Conversely, income diversification opportunities and proximity to off-farm activities can facilitate daily commuting flows and resilience against climate hazards (ibid.).

In terms of individual and community well-being, the outcomes of such mobility can be mixed. While movement can improve income diversification and access to new livelihoods, it can also affect community cohesion, resulting in high psychosocial costs and the establishment of informal settlements in hazard-prone areas (Bergmann et al. 2021). In many instances, hazard-driven mobility remains an obligation, rather than a choice: "migration is unwanted and does not represent a choice, but rather a lack of alternative income opportunities" (Sperling et al. 2008, p. 40). Urgent planning and policy actions are required to address such forced displacement, which could rise in unprecedented ways. The report identifies three major threats that could drive substantial migration by the end of the century: rapid and extensive deglaciation; more El Niño events combined with higher sea levels; and extreme heat stress combined with massive rainforest degradation (Bergmann et al. 2021).

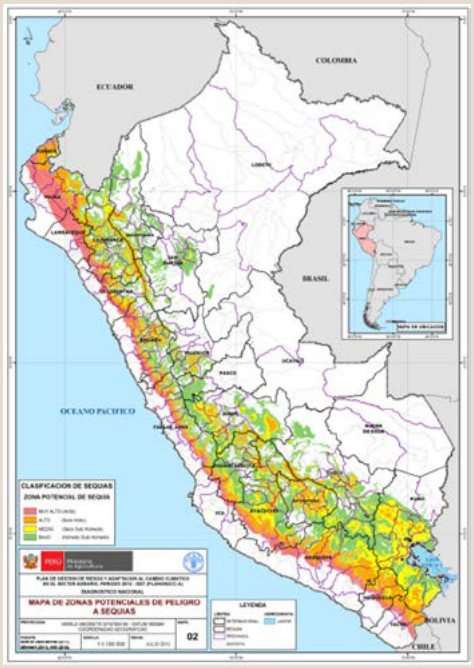


Figure 20. Areas at risk of drought in Peru. Source: MINAGRI, 2012, p. 36. Reproduced with permission. This map is for illustration purposes only. The boundaries and names shown and the designations used on this map do not imply official endorsement or acceptance by the authors, IOM or the Potsdam Institute for Climate Impact Research. Clasificación de Sequias (Zona Potencial de Sequia)/Drought Classification (Potential Drought Areas): Muy alto (arido)/Very high (arid); Alto (semi-arido)/High (semi-arid); Medio (seco, subhúmedo)/Medium (dry to sub-humid; Bajo (húmedo subhúmedo)/Low (humid to sub-humid). Leyenda/Legend: Límites/Borders – Internacional/Internacional; Region/ Region; Provincia/ Province; Distrito /District; Hidrografía / Hydrography – Lagos /Lakes (Translation by the authors).

4

CLIMATE, NATURAL RESOURCES AND MIGRATION – STATISTICAL ANALYSIS OF PLAUSIBLE CONNECTIONS IN AFRICA

Much of the existing quantitative research linking the environment and migration focuses on the marginal influence of temperature and rainfall on migration flows (see the 2020 meta-analysis by Hoffmann et al.). One of the recent key findings has been the contrasting impact of temperature and precipitation shocks on international migration from middle-income economies compared with poorer countries (see, for example, Missirian and Schlenker 2017, or Gröschl and Steinwachs 2017). In middle-income countries, higher temperatures are associated with increased migration rates to other countries. In poorer countries, the reverse is observed – with higher temperatures decreasing the probability of migration to other countries (Cattaneo and Peri 2016). Suggested reasons for this difference are that international migration is a costly process and, in poorer countries with agriculturally based livelihoods, high temperatures are associated with a reduced probability of would-be migrants having the resources to move (Hoffmann et al. 2020). The aim of this chapter is to present new empirical evidence on the role of environmental shocks and their interactions with natural resource availability as determinants of migration flows.

The causal pathway linking climate to migration has often been assumed to occur via the influence of climate shocks and stress on natural resource-based livelihoods, such as agriculture. From a theoretical point of view, the effect of such shocks is ambiguous. Affected farmers may be driven to look for other viable land after environmental change reduces the yields of their plots, but the reduction in income may trap these populations and reduce their mobility. The difficulty of empirically assessing the natural resource-migration link is related to the potential sensitivity of resource variables to migration-related increases or decreases in population, while resource variables are also a potential cause of migration. For example, improved land productivity could be a cause of migration, as migration becomes more affordable, as well as a result of decreased population pressure on land due to outmigration. In recognition of this reverse causality problem, the approach taken in this chapter is to focus on a common stressor on natural resources, namely drought, and its statistical association with migration. In a number of countries, agricultural productivity is directly linked to the strength of the economy, implying that drought can also affect non-agricultural sectors, albeit to lesser degree (Burke et al. 2015). The agricultural sector is still a highly relevant source of income in many developing countries, particularly in rural areas.

This chapter examines this agricultural pathway to migration in more detail, highlighting the mechanism of deteriorating land resources due to drought. In particular, the statistical relationship between the Standardized Precipitation Evapotranspiration Index (SPEI) and international migration flows, sub-national population densities and thus internal migration flows is explored. The SPEI is a measure of drought and, by extension, is an indicator of stressed land resources in terms of productivity. This examination of land resource degradation is extended to consider the influence of soil carbon on migration flows. Finally, the chapter explores whether the presence of mineral resources acts as a mediating factor in the relationship between drought and migration.

4.2 Literature review

Sub-Saharan Africa has received considerable attention from researchers working on the empirical linkages between climate and human mobility. Most of the existing studies have analysed the year-to-year correlation between weather phenomena and migration. For example, in multi-country studies of Sub-Saharan Africa, Barrios et al. (2006) analysed the link between average rainfall and urbanization, while Marchiori et al. (2012) estimated how temperature and precipitation anomalies affect migration outcomes. Within this strand of literature, there is no consensus around any robust relationship with a clear direction of association between climate and migration, although some stylized facts can be inferred from the empirical literature (see Hoffmann et al. 2020; Beine and Jeusette 2021). Climatic shocks may induce migration on the one hand and constrain migration on the other. Cross-national studies based on household surveys and micro-censuses report mixed evidence: whilst increased temperature is associated with higher international migration in Uganda, outmigration decreases with temperature rises in Burkina Faso and Kenya, and no relationship is found between migration and temperature anomalies in Nigeria and Senegal (Gray and Wise 2016; Nawrotzki and Bakhtsiyarava 2017). Looking beyond Africa, even within a country, studies often fail to find a consistent pattern of association. For example, rainfall deficits suppress United States-bound migration from rural Mexico according to some studies (Hunter et al. 2013; Nawrotzki et al. 2015) but increase migration according to others (Barrios Puente et al. 2016). Likewise, a set of macro-level studies of bilateral migration between countries also report inconsistent findings, with international migration increasing with higher temperatures in some cases (Backhaus et

al. 2015; Cattaneo and Peri 2016) and not affecting migration in others (Beine and Parsons 2015). Meta-analytical results confirm the heterogeneity of effects reported on the climate-migration link in the empirical literature (Hoffmann et al. 2020).

4.3 Modelling the effect of drought on migration

The decision to migrate is the result of complex reasoning and is influenced by external factors such as poverty, social and political exclusion, conflicts, labour requirements and many household characteristics (such as size, income and landholdings). To analyse such decisions, economists often use modelling frameworks that build upon comparisons of potential emigration costs and gains. Here, emigration costs might be interpreted as monetary costs (such as the cost of relocating) or non-monetary (including psychological) costs. While economists assume people assess these gains and costs similarly, they recognize that households do not necessarily react to the same environmental changes in a similar way. If environmental degradation and drought can push migration for some households, they can also hamper the decision for others by decreasing the local economic resources needed to migrate. The impact of drought on migration is probably indirectly mediated by physical, economic and political factors, which are in turn affected by environmental change (Abel et al. 2019; Richard Black et al. 2011; Fussell et al. 2014). Drivers of migration (climate, political factors, economic conditions and conflict) tend to be assessed simultaneously in the existing literature, without considering the causal structure through which migration is determined.

In line with Cattaneo and Peri (2016), this study aims to identify the total effect of drought on emigration, test interactions with the income level of the country of origin, disentangle potential non-linearities in drought severity and suggest potential channels and explanations. As income and productivity are affected by adverse climate events, this approach facilitates the identification of the total impact of droughts on migration and potential channels, rather than isolating its partial effect. In order to identify a relationship between drought, land degradation and migration decisions, aggregated international data and disaggregated (grid-level) data on migration and population density are used. More specifically, information on variables of interest is collected at the national and at the 0.5 × 0.5 degrees cell level. While the national level analysis relies on survey data on international emigration decisions, the disaggregated approach accommodates other phenomena of human mobility – particularly in terms of internal migration (which is often not accounted for in national analyses).

Both analyses follow the same estimation strategy involving regression of potential migration responses on drought and potential mediators. In that sense, the following specification represents the reduced formed equation that links drought and international/local migration:

$$Pop_{j,t} = \alpha + \gamma_1 C_{j,t} + \gamma_2 D'_{j,t} + \gamma_\rho C_{j,t} \times D'_{j,t} + \phi_t + \phi_j + \varepsilon_{j,t},$$

where $\mathbf{Pop_t}$ captures the human mobility variable of interest, either emigration as a share of total population in the international case and log-population measures at the local level; $\mathbf{C_{j,t}}$ captures the potential effect of location-specific drought events on emigration; and $\mathbf{D'_{j,t}}$ and $\mathbf{C_{j,t} \times D(j \in P)}$ capture co-determinant effects on migration. Then, ϕ_t and ϕ_j capture time and region/cell fixed effects. By including fixed effects, the study was able to control for all time-invariant cell-specific factors impacting migration such as the distance to the port, distance to capital, distance to borders or the existing network in other regions/countries (such as the presence of an ethnic group in destination cities). For the analysis at the international level, region-by-time fixed effects were included to capture region-specific effects that were potentially confounding the estimation. Such region-specific characteristics include a range of determinants such as global climate pattern, the price of natural resources (including oil prices) or global economic cycles. As a result, these estimates are less likely to be biased by any unobserved third factors.

Finally, a similar specification was estimated using land degradation (proxied by the soil carbon content) instead of drought to estimate whether land degradation may have a direct effect on migration. However, contrary to the preferred indicator of drought (the SPEI index), the interpretation of effects associated with this indicator is potentially subject to reverse causality, as population density is likely to impact land degradation and therefore its proxies.

4.3.1 Data

To estimate the effects of drought on migration decisions, aggregated international data and disaggregated (grid-level) data are used. The two main sources of population and migration data, respectively, are Özden et al. (2011) migrant stock data (1960-2000) and the Gridded Population of the World (GPW) dataset. The Gridded Population of the World (GPW) collection, now in its fourth version (GPWv4), models the distribution of human population on a continuous global raster surface. Since the release of the first version of this global population surface in 1995, the essential inputs to GPW have been population census tables and corresponding geographical boundaries. The purpose of GPW is to provide a spatially disaggregated population layer that is compatible with data sets from social, economic and earth science disciplines, as well as remote sensing. The fourth version of GPW (GPWv4) is a raster data collection of globally integrated national population data from the 2010 round of Population and Housing Censuses, which were carried out between 2005 and 2014. The input data are extrapolated to produce population estimates for the year 2000. One major drawback of using these data is that the population changes estimated in the GPWv4 data are also affected by changes in birth and death rates, as well as the difference between the two. This analysis assumes these rates remain stable within cells and that they are captured by the cell fixed effects. This implies that immigration effects may be overestimated in locations where birth rates increase or mortality falls in a given period, with the opposite holding true for emigration effects. The data at the required level of scope and disaggregation do not allow for a better measurement of human mobility, although current efforts aimed at estimating migration at a high spatial resolution may provide more precise information in the near future (see Alessandrini et al. 2020).

The analysis of international migration uses data from Özden et al. (2011), and provides information on migrant stocks spanning the period from 1960 to 2000. Those stocks are converted into emigration flows by adding all net flows for the same countries of origin and computing emigration rates as the ratio between the decade's aggregate net flow of emigrants relative to the origin country's population at the beginning of the decade. The main advantage of these data is that they are drawn from national censuses, which are much more accurate in counting foreign-born individuals than flow measures. As the data are only available every ten years, migration responses capture long-term tendencies - a characteristic that is specifically covered by this study's estimation strategy.

The main explanatory variable here is drought, as it potentially affects livelihoods and the natural resources on which they depend. The SPEI developed by Vicente-Serrano et al. (2010) is used to capture such conditions. The SPEI is a multi-scalar drought index based on climatic data that is normalized to mean zero and unit variance. It can be used to determine the onset, duration and magnitude of drought conditions with respect to normal conditions in a variety of natural and managed systems such as crops, ecosystems, rivers, water resources and so forth. A value of zero means that the water balance is exactly at its average; a value of plus one (or minus one) means that the water balance is one standard deviation above (or below) the average. The SPEI is constructed using a range of weather, climate and time-invariant factors to measure drought severity according to its intensity and duration, and can also identify the onset and end of drought episodes. Furthermore, the SPEI allows comparison of drought severity through time and space, since it can be calculated over a wide range of climates. One of the limitations of the SPEI as a measure of drought is the fact that it does not consider the growth cycle of crops (Pei et al. 2018). To overcome this drawback, climate information provided by the Climatic Research Unit (Harris et al. 2020) is used to evaluate the SPEI around location-specific growing seasons of the most cultivated crop. To do so, crop data on production and harvest areas and crop calendars are extracted from the global data set of monthly irrigated and rain-fed crop areas for the year 2000 from the Food and Agriculture Organization of the United Nations (FAO) (Portmann et al. 2010). Using location-specific SPEI evaluations of growing seasons provides a direct link between SPEI and patterns over the growing cycle to capture the role played by environmental shocks as a determinant of agricultural productivity.

The international analysis compares SPEI trajectories across countries and decades. Differences between in period-average SPEI scores are compared with long-term levels of SPEI. Those periods range from two to ten years. Worsening SPEI scores are indicated by lower period averages compared with the country-specific long-term levels. Comparing effect size estimates across those period comparisons sheds light on long-run migration responses to worsening climate conditions and, by extension, a proxy of worsening land-based natural resources. At the grid-level, the work of Laurent-Luchetti (2019)

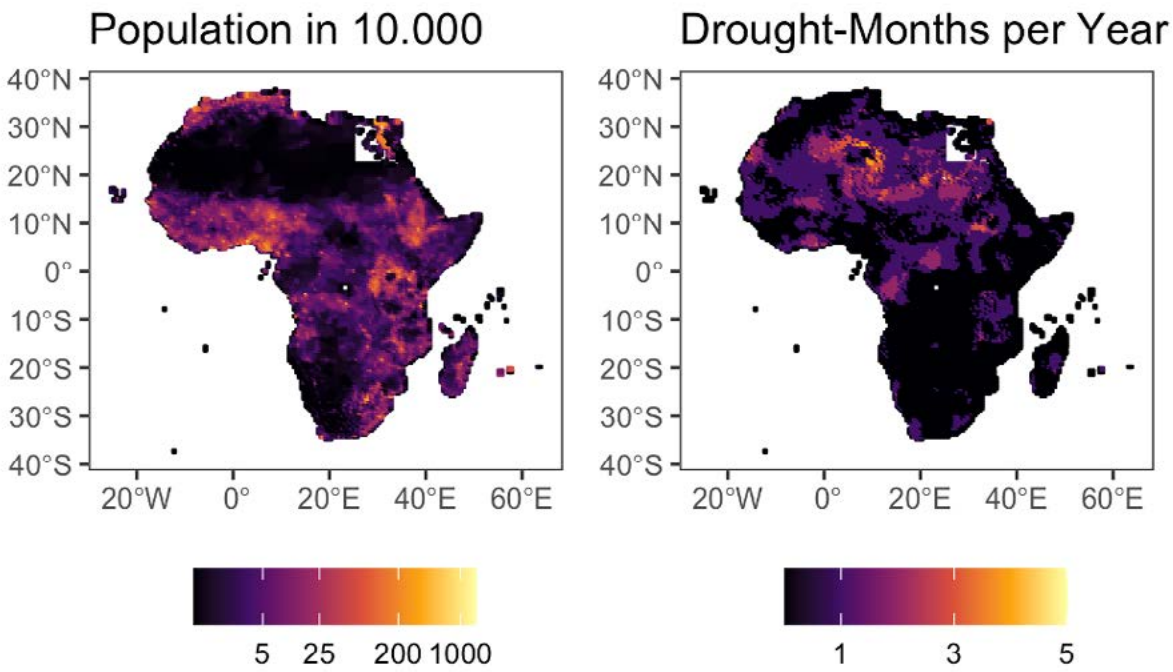


Figure 21. Left panel: Population projections in 10,000s for the year 2000. Right panel: Drought durations by cell evaluated in the year 2000. Drought duration is measured in fractions of past 12 months. A value of 0.5 means that 6 of the past 12 months were classified as drought periods (growing season SPEI lower than -1.5)

is used to construct a measure of drought periods as the proportion of months with SPEI scores below -1.5 out of the past 12 months. That is, for a year where the longest consecutive streak of months below -1.5 is three, the cell will be given a value of 3/12 = 0.25. When the longest streak starts in the previous year, it is counted and included in the year in which the streak ended. Theoretically, the proportion can therefore be above unity. This measure is aggregated for the past two years to capture longer drought periods, as grid-level migration data are only available every five years. Land degradation data in the form of changes in soil carbon stocks come from the Trends.earth project (González-Roglich et al. 2019). In order to estimate potential tempering effects of alternative sources of income (mineral resources), the Mineral Resources Data System (MRDS) is used.[22] The MRDS is a collection of reports describing metallic and non-metallic mineral resources throughout the world. Deposit name, location, commodity, deposit description, geological characteristics, production, reserves, resources and references are all included. Deposit locations are aggregated at the grid-level to proxy resource and labour availability.

All the datasets are matched to the PRIO-GRID structure – a standardized spatial grid structure with global coverage at a resolution of decimal degrees (Tollefsen et al. 2012). The PRIO-GRID dataset is a grid structure that aids the compilation, management and analysis of spatial data within a time-consistent framework. It consists of quadratic grid cells that jointly cover all terrestrial areas of the world.

Each grid cell contains cell-specific information on armed conflicts, socioeconomic conditions, ethnic groups, geophysical attributes and climatic conditions.[23] This analysis uses a number of those cell-specific attributes to investigate the potential heterogeneous effects of droughts and land degradation. These attributes include information on natural resources (presence in a cell of oil, diamonds, gold or gems), distances between the centroid of the cell and international borders and to the capital city, as well as topological features of the cell (whether it is mountainous terrain; and land composition).[24]

22 https://mrdata.usgs.gov/mrds/.

23 Note, however, that some these variables are time invariant or represent average values over the period of analysis. This is particularly relevant for the presence of mineral resources and geophysical attributes.

24 Replication data and codes are publicly available via Harvard Dataverse: "Replication Data for: Pathways to migration: the role of natural resource degradation" https://doi.org/10.7910/DVN/QXP0TY. Harvard Dataverse.

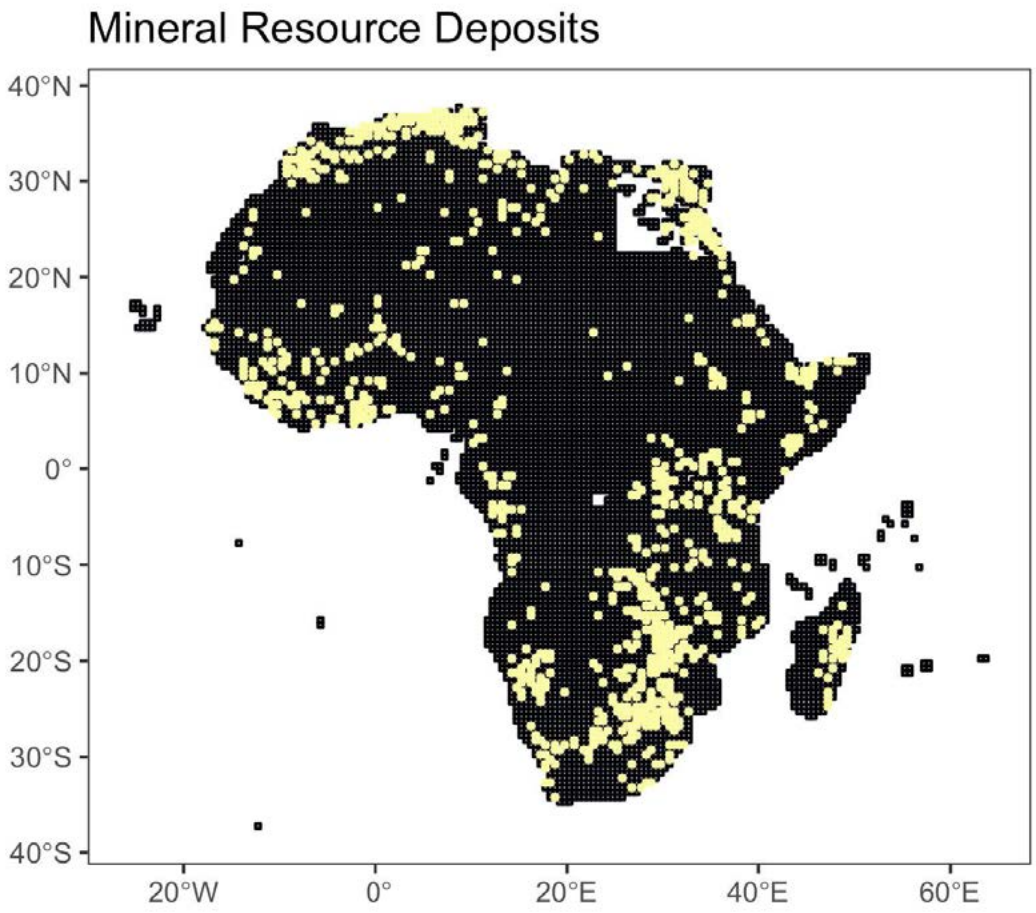


Figure 22. Currently active and past locations of mineral resources extraction sites (MRDS). MRDS are aggregated within each cell[25]

4.3.2 Descriptive statistics

The final dataset comprises information on 10,667 cells across four years, yielding a total of 42,936 observations. The left panel of Figure 21 shows the gridded population estimates provided by GPWv4 for the African continent and the year 2000 - the initial year of this empirical analysis.

Over the full sample, the average cell has about 91,966 inhabitants. Furthermore, the average Gross Cell Product adjusted for purchasing power parities is about 0.1625 US dollars per cell with a maximum of 20.3 US dollars.

The right panel of Figure 21 displays cells that were subject to a drought in the year 2000. As shown, drought periods are clustered, raising the issue of potential spatial autocorrelation which would need to be accounted for in the estimation model. Furthermore, severe drought events affect cells with very low population densities. Finally, Figure 22 displays both active and currently inactive mineral resource deposits. As there are no data on actual extraction volumes, resource deposits aggregated to the grid level are used as a proxy for potential sources of income different from agriculture.

25 Active and inactive locations are included, as there is little to no information available to determine the time frame of sites being operational. However, the known presence of mineral resources makes it possible to differentiate between cells where income generation due to mineral resource extraction might be possible and cells where such operations are not viable. In that sense, these estimates represent a lower bound for the subset of cells that have mineral resource deposits.

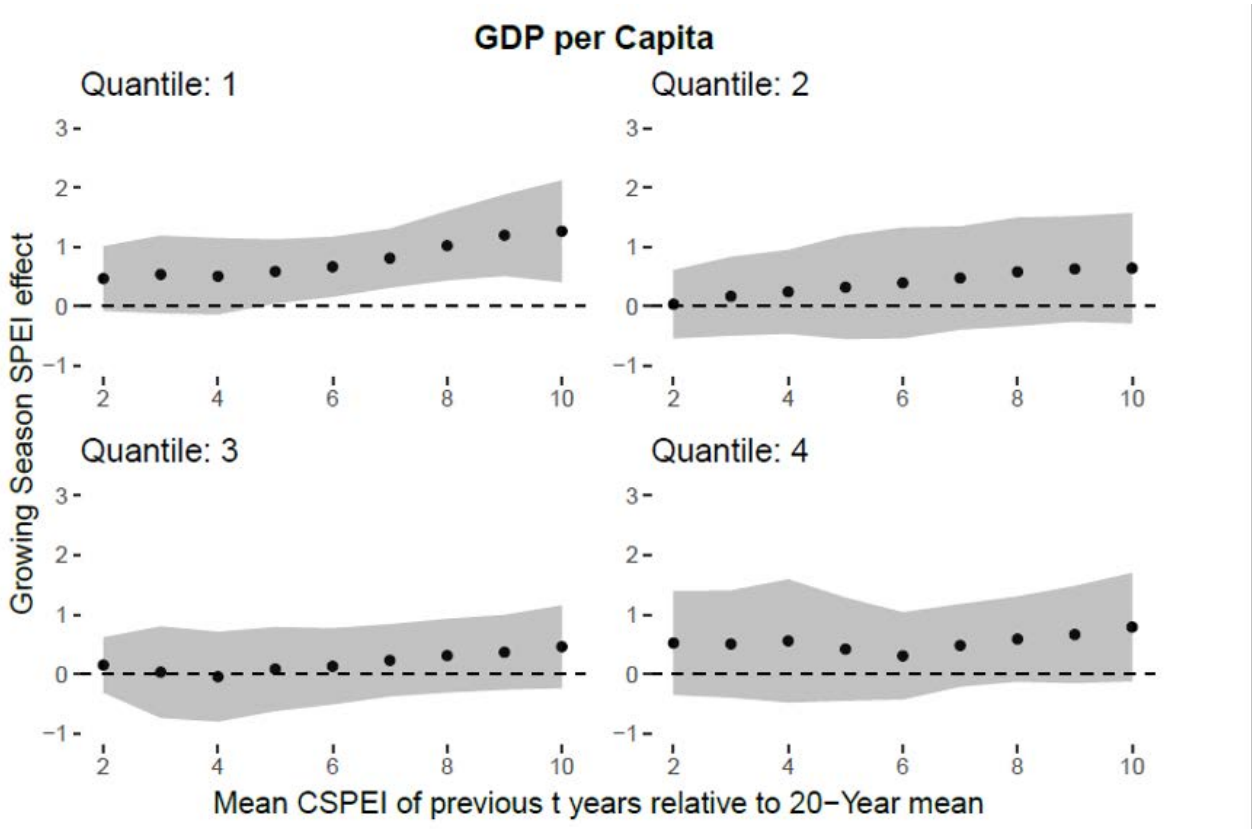


Figure 23. SPEI-trajectory effects estimates on log international emigration rates, by income quantile in the sample. The horizontal axis depict different lengths of the period of worsening drought conditions, from short (2 years) to long (10 years) periods. The vertical axis shows the corresponding effect on emigration rates (semi-elasticity). Estimates plus/minus twice their standard deviation are shaded. Standard errors are clustered at the regional level. The model also includes region-by-decade fixed effects to account for potential regional confounders.

4.4 Results

4.4.1 International migration

Figure 23 shows the effect estimates of the response of international migration to variations to SPEI trajectories during the growing season. SPEI profiles are obtained by relating yearly average SPEI levels to 20-year country averages using the following equation:

$$SP_{itp} = \frac{\frac{1}{p}\sum_{t}^{p} SPEI_{it}}{MSPEI_{it}^{20}}; p = 1,\ldots,10; MSPEI_{it}^{20} = \frac{1}{20}\sum_{t}^{20} SPEI_{it},$$

and thus represent relative SPEI values as compared to the long-run dynamics of the series. Depending on the value of p chosen, the variable reflects short-run dynamics in drought risk (for low values of p) or changes in the longer run (for high values of p). Lower values of SPEI are associated with falling profiles in SPEI if the overall trajectory is close to linear. Clearly, one limitation of this approach is a weakness in capturing highly non-linear SPEI trajectories, that is (inverse) u-shaped SPEI dynamics. However, since average period SPEI and not yearly SPEI values enter the equation above, this issue is not expected to affect the analysis considerably. In that sense, estimation results using the SPEI trajectory measure are to be interpreted as long-run (improving) worsening climate conditions as opposed to single events of droughts and thus capture (decreased) increased drought probability over the period in question.

	(1)	(2)	(3)	(4)	(5)
Explanatory variable	Drought	Drought	Drought	Drought	Land degradation
	-6.649***	-0.549***	-0.127***	-0.126***	-0.151
	(1.050)	(0.192)	(0.00962)	(0.0391)	-0,224
Cell fixed effects	No	Yes	Yes	Yes	Yes
Year fixed effects	No	No	Yes	Yes	Yes
Adjusted standard errors	No	No	No	Yes	Yes
Obs	41,868	41,868	42,064	41,868	36,863
R^2	0,004	0,004	0,004	0,004	0,002

Table 1. Effects of drought events (columns 1 to 4) and soil degradation (column 4) on population. Dependent variable is population at the cell level. In parenthesis, (heteroskedasticity and autocorrelation-consistent, HAC) standard errors, * p<0.10, ** p<0.05, *** p<0.01.

In line with previous contributions, such as Cattaneo and Peri (2016), there are statistically significant effects of drought on migration, although these results differ in part from those found in the literature. The upper-left panel in Figure 23 shows the effects of SPEI trajectories on migration rates for countries below the first income quantile in the sample. Significant drought effects are exclusively associated with this subsample of relatively poor countries, and only appear for relatively long-lived drought episodes. In economies in which agricultural productivity is so low as to leave rural populations with liquidity constraints and limited to the primary sector, worsening (improving) climate and lower (higher) agricultural productivity may slow (increase) economic transformation and economic growth. These effects ultimately contribute to poverty traps. Unfortunately, one caveat of using data taken from Özden et al. (2011) is that they cover a period where data on resource extraction volumes are scarce - especially when focusing on poorer countries. In order to investigate potential tempering effects that resource availability as an alternative source of income might have on negative climate shocks, grid-level data sourced from fairly recent surveys are used.

4.4.2 Grid level

Table 1 displays the estimates based on the specification relating drought and land degradation to log-transformed grid-level population projections. Column 1 displays a weak correlation of the drought measure with log-population levels without controlling for any time and cell (that is, grid-level) fixed effects.

By not including cell and time fixed effects, cell- and time-specific confounding factors are implicitly allowed to bias the estimation results. For example, if cells in rural areas are more likely to experience both drought and strong migration toward urban areas, cell fixed effects would have to be added as this higher migration tendency would create a spurious correlation in models that do not account for such time-invariant unobservable variables. Confounding factors that are associated with time would be time-specific events - such as El Niño or region-wide conflict potentially spurring migration - that affect many cells at a time.

The results in columns 1 to 3 show the obvious importance of cell- and year-fixed effects to control for cell and time invariant confounders, which are dealt with by including cell-fixed effects in column 2, and cell- as well as time-fixed effects in column 3. Part of the effect of droughts on migration might also be due to spatial correlation - that is, the fact that drought is hardly cell specific but affects neighbouring cells in a similar way. This is especially true in a grid-cell setting. To control for spatial correlation, columns 4 and 5 use standard errors that are estimated with a spatial heteroskedasticity and autocorrelation consistent (HAC) correction, allowing for both cross-sectional spatial correlation and location-specific serial correlation, applying the method developed by Conley (1999).

Column 4 displays the preferred specification, which shows a statistically significant and sizeable negative effect of prolonged drought periods on cell-level population. As the main explanatory variable is measured in fractions of a year, dividing the parameter estimate by 12 gives us the effect of one additional month of drought, which would decrease the population in that cell by about 1%. Given the mean population per cell is about 91,966, a reduction of 1% represents about 919 people per cell. Assuming constant birth and death rates, this estimate implies that droughts cause a total number of 9.8 million people to leave their initial cell of residence. Clearly, as droughts might affect births and deaths, the assumption of constant birth and mortality rates is rather restrictive. This is particularly relevant as, given the international results presented in Figure 28, only a small fraction of those 919 people per cell represent actual migrants - underlining the potential negative consequences of immobile populations. Column 5 presents the estimation results that relates soil carbon degradation to potential migration responses – indicating small to no detectable effects. It should, however, be emphasized that it is extremely challenging to obtain reliable estimates of soil carbon changes, and that the existing data may be subject to measurement error.[26]

4.4.3 Heterogenous results

To explore potential non-monotonic effects of drought severity, Figure 21 displays the effects of different drought durations on migration measures. Drought levels rank from two to more than six consecutive months with SPEI levels below -1.5, which are then compared to cells experiencing less than 2 months of drought.

As expected, more intense drought periods have more severe impacts on migration. However, this study's relatively imprecise drought severity estimates rule out any inference of non-linear changes in absolute effect sizes.

Income

On the basis of Cattaneo and Peri (2016), potential heterogeneous resilience to drought periods was analysed by interacting the main explanatory variable with projections of purchasing power parity adjusted gross cell product evaluated in the initial year of the period. These projections are obtained from the latest version of the Global Gridded Geographically Based Economic Data (G-Econ; Nordhaus 2006). The data are computed by spatial rescaling based on existing figures from subnational administrative units using a proportional allocation rule based on cell population and area. As displayed in Figure 22, relatively richer cells are far more resilient towards drought periods compared with the poorest cells in the income distribution. Part of the heterogeneity might be explained by the fact that agricultural dependence is most prevalent in poor cells and alternative sources of income tend to be more accessible in higher income cells.

Accessibility and urbanization

The higher resilience of 'richer' cells might also be due to their relatively higher urbanization rate. To investigate whether the interpretation of the effects of droughts being more severe for rural areas is correct, Table 2 displays the estimation results of a specification where the baseline drought effects interact with the cells' distance to the capital and the cells' urbanization rate (measured as a percentage of the cell considered to be urban).

Column 2 in Table 2 shows that relatively more urbanized cells tend to be more resilient to droughts than cells with rural attributes. This supports the idea that a lack of alternative means of income in rural regions is the main driver of the negative drought effects on migration.

26 See https://trends.earth/docs/en/background/understanding_indicators15.html.

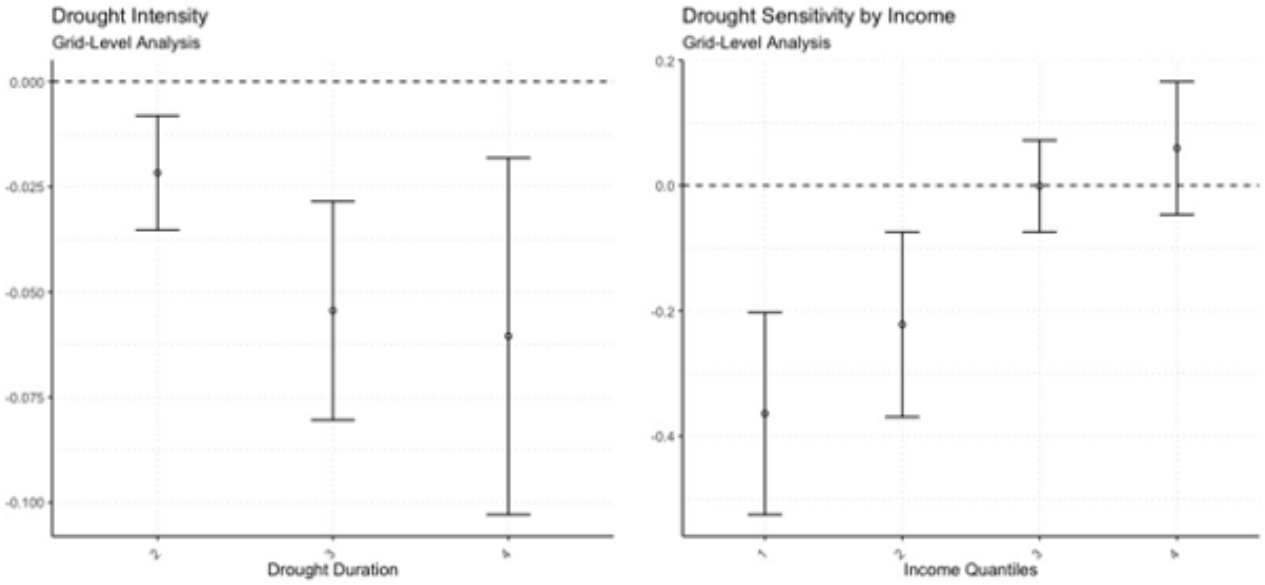


Figure 24. Left panel: heterogeneous effects of drought incidence by drought-severity measured in fractions of 24 months. The baseline group is specified to have reported drought periods - SPEI levels below -1.5 - with duration less 10 percent of the past 24 months. Groups 2-4 reported drought periods that spanned 10-20, 20-50 and more than 50% of the past two years. Right panel: heterogeneous drought effects by cell-income-quartiles measured by log-transformed purchasing power adjusted gross cell product in US dollars

	(1)	(2)
Drought event	-0,117**	
	(0,052)	
x Closeness	-0,008	
	(0,013)	
x Urbanization		0,043**
		(0,017)
Cell FE	Yes	Yes
Year EE	Yes	Yes
HAC SE	Yes	Yes
Obs.	42,664	42,672
R^2	0,006	0,006

Table 2. Effects of drought events (columns 1 to 4) and soil degradation (column 4) on population (HAC) standard errors in parentheses, * p<0.10, ** p<0.05, *** p<0.01

Resources

Another alternative income source is the presence of mineral resources. Developing countries have access to many of the world's largest oil and mineral reserves. They are among the largest producers of key minerals and account for most of the growth in mineral production (Humphreys 2009). Existing empirical literature suggests that an abundance of natural resources may fail to improve living standards, or even hinder economic performance, especially in the presence of weak institutions (Mehlum et al. 2006). Most of the evidence comes from aggregate data at the country level and offers little guidance about the local economic effects of resource abundance. According to this study, however, mineral resources might actually provide income in times where agricultural yields dwindle. In line with Aragón and Rud (2013), this study found positive effects of mineral resource presence within a cell in terms of sensitivity to SPEI changes. In other words, adverse drought effects are dampened by the presence of mineral resources, probably due to the possibility of access to an alternative source of income.

4.5 Discussion

This chapter focused on the impact of drought and land degradation on internal and international migration. The impact of drought on migration was studied through the effect on agricultural productivity, in order to test the hypothesis that communities experiencing greater environmental stress may have suffered declining agricultural productivity leading to mobility. This phenomenon, which should mainly affect rural populations, has differential consequences on emigration rates depending on the income level of potential migrants. In very poor countries, where the main obstacle is the unaffordability of emigration, warming and lower rural income may imply less emigration. In countries where income is not as low, however, lower agricultural productivity will enhance the incentives to migrate to cities or abroad. Consistent with this theoretical framework, drought episodes were found to be associated with lower human mobility in low-income environments. On the other hand, alternative sources of income were found to greatly improve drought resilience at the national and subnational levels. By combining both international and subnational models, previous findings on drought resilience (Laurent-Luchetti 2019; Cattaneo and Peri 2016) were extended to shed light on the importance of local income sources other than the drought-sensitive agricultural sector. Furthermore, droughts seem to be mostly related with subnational migration decisions as opposed to international migration. As the latter tends to require more money to be viable, droughts (by their adverse effects on agricultural productivity) cause poverty traps at the national level. Given worsening climate conditions and increased incidences of drought in the future, investment in and development of alternative sources of income seem paramount in alleviating natural-resource-related climate stresses in severely affected communities.

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5

SYSTEMS ANALYSIS OF COMPLEX PATHWAYS LINKING RESOURCES AND HUMAN (IM) MOBILITY

5.1 Introduction

When analysing the link between natural resources and migration, three main framings are often used to understand the phenomena involved. The first is where people are considered forced to move because individuals, households or society are detrimentally affected by a degradation or reduction of natural resources available to them. The second framing is where the process of migration is seen as an adaptation to the loss or potential loss of natural resources. The migration process may not only reduce exposure to resource loss and degradation but may provide income and skills that can be used to build resilience to shocks and stresses. In both of these framings, natural resources can be seen as conduits of climatic stress and shocks. However, resource degradation and loss can also be a result of non-climatic reasons including poor resource governance. The third framing is where migration is seen as a response to the perceived opportunity provided by natural resources, such as resource mining. Clearly these framings are not mutually exclusive, and people can be forced to move and, in the process of migration, this can help them adapt. Likewise, populations may choose to migrate to cities for reasons totally unrelated to resource loss, but then be exposed to new risks that are a symptom of resource degradation.

Focusing on the role of natural resources in (im) mobility decisions and outcomes makes it easier to identify more targeted regional, national and local policy intervention points, rather than simply considering the link between climate change and (im)mobility. In this chapter, policy space is based around the following assumptions. The first is that (im)mobility should be based on a rights approach, as people have the right[27] to stay or move to/within their country, and they should not be discriminated against for being migrants or for deciding to stay in an environmentally risky area. The second assumption is that the sustainable management of resources provides the platform for people to enjoy this rights-based approach. In a sense, the aim of policy in this area is to try to decouple the degradation of natural resources from (im)mobility. The third assumption is the aim of integrating migrants and the process of migration into achieving the sustainable management of resources.

In order to identify the entry points for policies to ensure these aims, this chapter takes a systems approach to illustrate the many processes linking (im)mobility and natural resources. In particular, it delves into the many sociopsychological, political, economic, environmental and demographic (SPEED) factors that have been identified in the relationship between resource degradation and human mobility. In this respect, the study largely adopts a vulnerability framing. However, the chapter also elaborates on how migration can be an adaptation strategy to resource degradation and loss, while remittances are a potential source of sustainable resource management funding. By highlighting the many connections between SPEED variables and the relationship between natural resources and (im)mobility, the analysis follows the paradigm of complex adaptive systems. Complex adaptive systems are typically characterized as uncertain, non-linear, co-evolving and having emergent properties. In terms of human (im)mobility, this may mean sudden migration flows of people or "trapped" populations unable to move (Adger et al. 2015; Black et al. 2011, 2013). In terms of natural resources, this may mean the collapse of ecosystem services or the sustainable management of resources.

In the past, a systems approach has been used to investigate linkages as diverse as mental health and drought (Vins et al. 2015), climate change and mental health (Berry et al. 2018), natural hazards and well-being in Bangladesh (Hayward and Ayeb-Karlsson 2021)[28] and interruption of treatment for human immunodeficiency virus (HIV) and drought in Africa (Orievulu et al. 2020). No study focusing on a systems analysis of the natural resource-(im)mobility nexus has been identified. There is, however, a more critical body of literature concerning the connections between natural resource scarcity, migration and social tension that has argued the need for more systemic research in this area (Brzoska and Fröhlich 2016; Burrows and Kinney 2016).

27 Article 13 of the Universal Declaration of Human Rights states that: (1) Everyone has the right to freedom of movement and residence within the borders of each state, and (2) Everyone has the right to leave any country, including his own, and to return to his country (UDHR 1948). For further details, see https://www.un.org/en/about-us/universal-declaration-of-human-rights.

28 Hayward, G. and Ayeb-Karlsson, S. (2021). Seeing with empty eyes: A systems approach to understand climate change and mental health in Bangladesh. Climatic Change 165, 29. https://doi.org/10.1007/s10584-021-03053-9.

With a view to illustrating the diverse and complex linkages between natural resources and (im)mobility, this chapter will cover three case studies. Two of the systems analyses are based on primary fieldwork data from Bangladesh and the Philippines, while the third is based on secondary data or a literature review covering eight countries in the Sahel region (Burkina Faso, Chad, Mali, Mauritania, Niger, Nigeria, Senegal and Sudan). The case studies differ in terms of the natural resource context, the environmental stress and shocks on these resource systems, as well as in the range of (im)mobility outcomes. To summarize, the analysis will include natural resource-(im)mobility pathways through: (1) sudden-onset environmental shocks in Bangladesh; (2) slow-onset environmental processes in the Philippines; and (3) climatic changes in the Sahel.

5.2 Natural resource degradation, mass migration and conflict – why the caution?

Recently, a growing number of natural resource degradation studies (mainly on land and water scarcity) have suggested that climatic stress may exacerbate social tension (or conflicts) due to the competition for access and control of declining natural resources. In the literature, intermediate social, political, financial and demographic processes such as income and food insecurity and/or forced displacement are used to explain the links between natural resources and conflict (Barnett 2003; Reuveny 2007; Raleigh 2010, 2011; Gleick 2014; Burke et al. 2015; Kelley et al. 2015; Abel et al. 2019).

Recently, a growing number of natural resource degradation studies (mainly on land and water scarcity) have suggested that climatic stress may exacerbate social tension (or conflicts) due to the competition for access and control of declining natural resources.

The case of Syria is perhaps the most widely used example linking drought-induced resource degradation, mass migration and conflict (Gleick 2014; Kelley et al. 2015).[29] More critical responses to such claims raised concerns for how ungrounded arguments were used to blame natural resource degradation on climate change, and framing population movements as a security threat. The natural resource degradation in Syria was strongly tied to poor national governance, political power relations and unsustainable resource management (Fröhlich 2016; Selby et al. 2017).

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29 For example, former United States President, Barack Obama, stated that climate-induced drought "helped fuel the early unrest in Syria, which descended into civil war", former United States Secretary of State, John Kerry, claimed that "it's not a coincidence that immediately prior to the civil war in Syria, the country experienced its worst drought on record", while the then Prince Charles in the United Kingdom argued that "there is very good evidence indeed that one of the major reasons for this horror in Syria was a drought that lasted for five or six years" (see further analysis in Selby et al. 2017).

In certain national contexts, some of the more linear connections between natural resource scarcity and degradation, population movements and conflicts have been criticized for being too simplistic and lacking in empirical evidence (Brzoska and Fröhlich 2016; Burrows and Kinney 2016; Nordås and Gleditsch 2007). In addition, migration scholars have urged more caution and focus on how such descriptions feed into alarmist and divisive narratives around "climate refugees" and "environmental migrants" (Ayeb-Karlsson 2020; Baldwin 2013; Bettini 2013).

5.3 Analysis of three natural resource systems pathways in Bangladesh, the Philippines and the Sahel

In this analysis, the empirical data are based on unstructured interviews and storytelling sessions conducted and supervised by the chapter's lead author.30 The sessions were part of two larger research initiatives that investigated people's subjective values, perception and feelings in relation to climate-induced migration and immobility in Bangladesh and the Philippines. The narrative analysis draws out how personal storylines illustrated the way in which climate-induced natural resources stress could lead to (in)voluntary (im)mobility. The Bangladesh case study builds on a dataset of fieldwork that was carried out between 2014 and 2016 involving approximately 800 gender balanced informants spread over seven study areas across the country, while the empirical data in the Philippines were gathered in 2020 and involved roughly 700 men and women spread over 12 study areas (six origin and six destination areas) in the three island groups Luzon, the Visayas and Mindanao.

The literature review draws qualitative data from publications on natural resource stress, climatic changes and (im)mobility in the Sahel region published before prior to 10 January 2021. The Web of Science database was used to source articles for screening due to its broad coverage of literature from the life science and natural science fields in relation to natural resource degradation. The following eight countries from the region were included: Burkina Faso, Chad, Mali, Mauritania, Niger, Nigeria, Senegal and Sudan. The articles included made reference to natural resources, climatic changes and (im) mobility. The natural resource element of the searches related to natural resource degradation such as land and soil decline, food (in)security, water (in) security and agricultural degradation. In terms of climatic changes, the search terms covered a broad range of environmental stressors including acute (such as floods, dust storms and wildfires) and slow-onset ones (such as drought, salinification and desertification). The search terms also cover themes of conflict and exploitation to capture issues of social tensions linked to natural resources or claimed to result from climatic changes in a way that potentially influenced (im)mobility patterns. Texts unrelated to the relevant countries or any natural resource impacts, climatic changes and human (im)mobility were excluded. A total of 394 publications were identified through the literature search, of which 24 met the inclusion criteria. The study selection approach is reflected in the choice of search terms (see Table 3 and Table 4)..

30 For more details on study locations, sampling, research methodology and empirical data, see Ayeb-Karlsson et al. 2016, 2019a, 2020, Ahmed et al. 2019 and Ayeb-Karlsson 2020b, 2020c, 2020d, for the Bangladesh case study, and Ayeb-Karlsson and Uy 2021a, 2021b for the study in the Philippines.

Table 3. Study Selection

Author	Country focus	Environmental stressors	Resource elements	(Im)mobility elements
Afifi 2011	**Niger**	• Drought	• Food shortages • Water shortages • Soil degradation • Livestock death • Fishing failures	• Restricted mobility of Fulani herders • Farmers moving north • Herder-farmer conflict • International migration, deportation and voluntary return • Women/elderly/children remain – labour burden
Akinyemi and Olaniyan 2017	**Nigeria**	• Drought	• Cattle-sensitive resource scarcity (grass) • Resource-related conflict: water pollution, crop damage/theft • Water scarcity/ competition • Cattle theft/poisoning • Poverty	• Pastoral migration • Herder-farmer conflict
Ayeb-Karlsson et al. 2019	**Senegal**	• Rainfall variability • High temperatures • Soil salinization • Strong wind events • Flash flooding • Storm surges	• Agricultural failures • Food shortages	• Immobility in unsafe spaces / places with limited adaptation options • Migration to urban slums areas • Women: gendered immobility • Livelihood change
Brottem 2014	**Mali**	• Drought • Rainfall variability	• Resource competition • Crop damage	• Livestock (im)mobility • Herder-farmer conflict • Herder settlement • Government policy: grazing zones, livestock corridors • Territorial issues
Djoudi and Brockhaus 2011	**Mali**	• Desertification	• Water shortages • Arable land loss • Food insecurity	• Men: seasonal/non-seasonal migration • Women: gendered immobility/ vulnerability; increased labour burden (women); illegal charcoal production; socially restricted mobility; opportunity for empowerment
Dries & Liehr 2015	**Senegal, Mali**	• Rainfall change	• Agricultural success/ failure	• Changing patterns of migration: duration, destination • Environmental change: lower impact on migration than socioeconomic conditions
Ele 2020	**Nigeria**	• Drought • Desertification	• Water shortages • Lake Chad shrinkage • Land scarcity • Famine • Decreased grazing vegetation	• Migration for alternative livelihoods • Forced herder migration • Herder-farmer conflict • Government policy: anti-open grazing laws, annexation of land, ranch establishment, grazing routes/reserves • Inter-country migration; porous borders; cross-border movement

Author	Country focus	Environmental stressors	Resource elements	(Im)mobility elements
Freeman 2017	**Niger, Senegal, Mali**	• Drought • Erratic rainfall • Erratic temperatures • Flooding	• Lake Chad shrinkage • Water/pasture competition	• Social/political/demographic/ economic context = intervening variables for migration decision • Pastoral migration, herder-farmer conflict • Tuareg (im)mobility + rebellion • Conflict: small-scale regional conflict, insurgent groups • International emigrants finance local development
Gueye et al.2015	**Senegal**	• Drought • Reduced rainfall	• Agricultural failures • Water shortages • Food shortages • Crop loss • Field loss, wind erosion • Reduced (cattle) fertility	• Increased mobility • Migration for employment • Rapid urbanization, consolidation of new cities • Informal/illegal settlements • Dense urban populations: flood vulnerability • Home ties • Cities hub of international departure / return
Henry et al. 2004 (a)	**Burkina Faso**	• Reduced rainfall	• Land degradation	• Limited mobility - trapped in unfavourable areas • Emigration to Côte d'Ivoire – coffee/ cocoa plantations • Ties to villages of origin/family networks
Henry et al. 2004 (b)	**Burkina Faso**	• Reduced rainfall	• Agricultural failures • Water shortages	• Migration behaviour dependent on individual characteristics: education, ethnicity • Rural-rural / short term migration • Long-distance movement restricted by environmental stress • Gendered mobility • Alternative livelihoods in risky environments
Howorth and O'Keefe 1999	**Burkina Faso**	• Drought	• Disappearance of forest/savannah zones • Soil loss • Lowered water table • Adoption of local farming practices • New resource-use patterns for shared livelihood subsistence	• Widespread Fulani pastoralist migration to sedentary Mossi areas • Trade, exchange, cooperation, negotiation • Assimilation + integration into social system
Ibnouf 2011	**Sudan**	• Drought • Desertification	• Food insecurity • Livelihood diversification- household garden plots	• Gendered (im)mobility • Unreliable remittances • Women: increased labour burden
Madu and Nwankwo 2020	**Nigeria**	• Desertification • Drought • Rainfall variability	• Food insecurity • Destruction of crops by herds	• Herder-farmer conflict • Population pressures in southern region

Author	Country focus	Environmental stressors	Resource elements	(Im)mobility elements
Morand et al.2012	**Mali**	• Rainfall variability	• Water insecurity • Decline in fish abundance	• (Adaptation of floodplain fishers) • Disruption to seasonal fishing migrations • Lack of flexibility to modify routes = trapped/immobile populations • Permanent emigration • Livelihood change
Nawrotzki et al.2016	**Burkina Faso, Senegal**	• Heatwaves • Drought	• Agricultural failure • Food insecurity	• Migration as income diversification • Drought limits international mobility • Increased rainfall increases international outmigration
Olaniyan and Okeke-Uzodike 2015	**Nigeria**	• Rainfall variability	• Decreased grazing resources • Cattle death • Land ownership disputes • Killing of cattle by local farmers • Crop destruction by cattle	• Increase in flow of migrants • Herder-farmer conflict • Lack of integration into host communities
Onwutuebe 2019	**Nigeria**	• Drought • Rainfall variability	• Decreased farm yields • Food insecurity • Water insecurity • Land grabbing	• Men: migration for alternative livelihoods • Women: gendered immobility; increased vulnerability; increased labour burden
Owonikoko and Momodu 2020	**Niger, Chad, Nigeria**	• Reduced rainfall • Drought • Lake Chad shrinkage • Desertification	• Unsustainable exploitation of lake resources • Water insecurity • Fishing, farming, hunting, herding • Arable land shortages • Livelihood loss • Competition for water resources	• Switch to criminal activities: cattle rustling, trafficking • Radicalization/recruitment by Boko Haram • Rural-urban migration • Urban social crises • Seasonal to permanent movement of pastoralists • Herder-farmer conflict • Cross-border movement to follow lake shores
Sanfo et al. 2017	**Burkina Faso**	• Reduced rainfall • Drought • Heatwaves • Crop parasites	• Land degradation • Reduced soil productivity • Reduced crop yields • Food insecurity • Child malnutrition • Reduced land availability • Land tenure insecurity • Deforestation	• Temporary + permanent migration • Family reunification • Immobility: poverty constrains migration • Trapped populations in food-insecure regions

Author	Country focus	Environmental stressors	Resource elements	(Im)mobility elements
Scheffran et al. 2012	**Senegal, Mauritania, Mali**	• Drought • Irregular rainfall	• Water insecurity	• Circular/seasonal migration • Nomadic pastoralism/ transhumance • Gendered mobility • Remittances: household income; emigrant financing local development projects • Return of international migrants • Strong migrant links with areas of origin
Seiyefa 2019	**Mali**	• Rainfall decline • Drought	• Water insecurity • Cropland erosion • Livelihood loss • Resource competition / capture	• Switch to criminal activities: smuggling, trafficking, kidnapping, illegal migration • Opportunistic recruitment to terrorist networks e.g. Al-Qaida • Marginalization and migration of weaker groups
Traore and Owiyo 2013	**Burkina Faso**	• Drought • Locust invasions	• Lack of good pastures • Natural resource competition/conflict • Crop failure • Livestock weakness/ death • Water insecurity • Food insecurity	• Decreasing reliance on transhumance as coping measure • Immobility increases vulnerability in drought • Shift from nomadic herding to crop and livestock keeping • Migration for alternative livelihoods • Disrupted family cohesion

Table 4. Study Selection

	Included	Excluded
Problem Population	• Natural resource pressures • Climatic changes (and subsequent environmental stressors) • Selected Sahelian countries (Senegal, Mauritania, Mali, Burkina Faso, Niger, Nigeria, Chad and Sudan)	• Publications not relating to climatic changes and subsequent environmental stressors • Populations outside of selected Sahelian countries
Interest	• Human (im)mobility and proximal determinants of migration such as livelihoods and conflict	• Not referring explicitly to natural resources or related determinants of human migration • Countries outside of the selected Sahelian countries
Context	• The Sahel region (a semi-arid region of high climate vulnerability characterized by high rainfall variability and periods of drought)	• Countries outside of the selected Sahelian countries
Publication details	• Texts published before 10 January 2021	• Texts published after 10 January 2021

A qualitative thematic narrative analysis was applied to identify the connections between natural resources and (im)mobility. From these connections, systems diagrams were drawn to highlight pathways that individuals or households follow in terms of natural resources to migration and immobility. Nine pathways were selected from the systems analysis to capture the diverse natural resource and (im) mobility connections in the context of environmental impacts in Bangladesh, the Philippines and the Sahel.

The result sections are structured around these nine pathways, which illustrate how access and availability to natural resources may increase or decrease a person's vulnerability to environmental impacts, and positively or negatively influence their (im)mobility experiences.

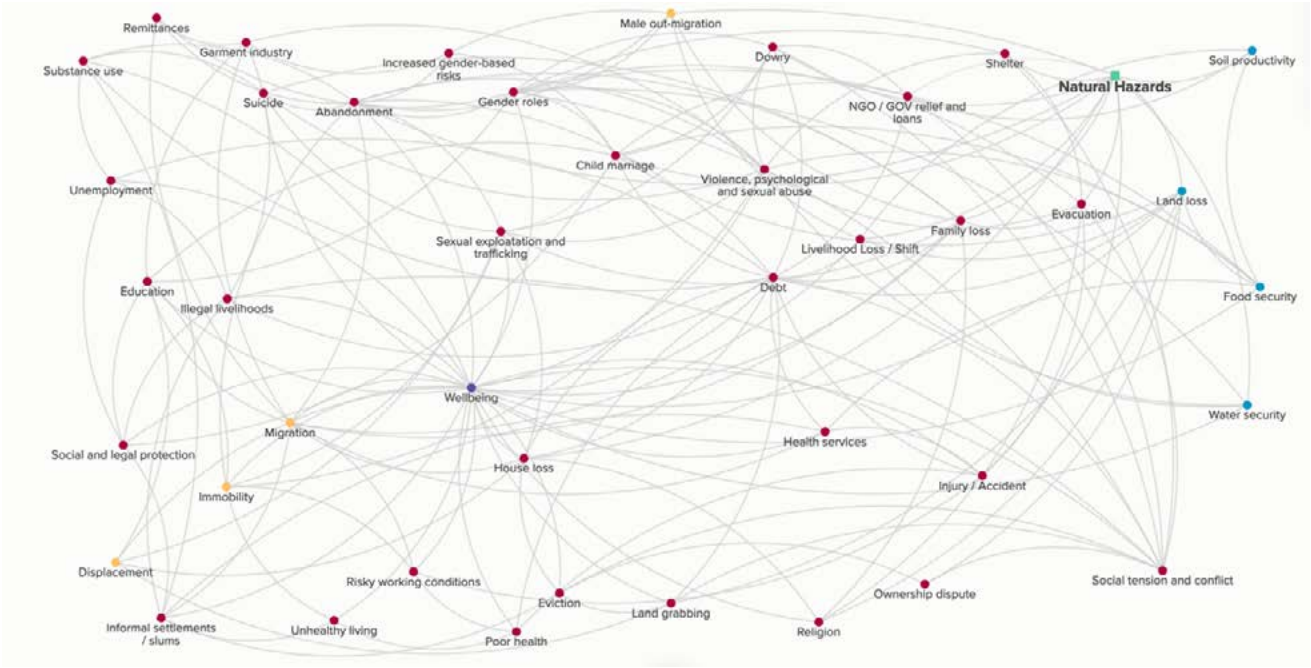

Figure 25. Systems diagram for the migration and immobility impacts of natural resource degradation in Bangladesh, based on unstructured interviews and storytelling sessions by the authors. Green dots represent the environmental impacts, blue ones represent natural resource-based factors, red dots are human and social factors, yellow ones outline the (im)mobility outcomes and the purple dots indicate well-being

5.4 Natural resource degradation and (im)mobility in the context of sudden-onset events in Bangladesh

Natural hazards are known to increase stress, strain and pressure on the natural resources that sustain most societies. In Bangladesh, extreme weather events such as cyclones and floods often damage soil and water resources while forcing people out of their homes, either in the short term through evacuation to shelters, or longer term in the form of displacement. Figure 25 shows a systems diagram summarizing the main pathways described by research participants. Respondent interview extracts are presented as key nodes of interaction and discussed to corroborate the causal pathway.

5.4.1 Pathway: Natural resource loss leading to displacement and eroded well-being[31]

The loss of land (and home) through cyclone strikes can result in Internally Displaced People (IDP), where displacement goes hand in hand with serious impacts on well-being. For example, a landowner suffers the loss of land and therefore a home, which can contribute to a loss of safety, belonging and even identity (Berry et al. 2008; Rezwana and Pain 2020; Haywards and Ayeb-Karlsson 2021).

This erosion of natural resources and well-being was described as directly linked to the cyclone impact. People were forced to abandon land, houses, livestock and livelihoods (agricultural and fishing tools) to evacuate and move family members to safety. Meanwhile, indirect causal links were seen through the process of migration and longer-term displacement in the wake of natural resource related losses. People described how dreams and hopes had been erased by the immediate impacts on natural resources and well-being related to the loss of land, soil, livestock and livelihoods (agricultural or fishing equipment):

31 In this chapter, well-being refers to "a subjective and dynamic state of feeling healthy and happy that ties into life satisfaction and influences a person's (or a collective's) psychological and social function" (Ayeb-Karlsson 2020a:2).

Extract 1[32]

When [cyclone] Aila struck we did not really face any severe loss of lives, but the crop fields got completely destroyed due to the saline water. Even today, we still cannot really cultivate large amounts of our fields since the land still has not recovered its productivity (Ayeb-Karlsson et al. 2016:688-689).

Extract 2

With time, these cows multiplied into 19 cows and we were doing quite well until Sidr, when we lost 10 cows out of the 19. Before [cyclone] Sidr I was even planning to send my youngest son to Saudi Arabia to work. However, when the cyclone struck, I could not manage to spare the money needed to send him there. We lost everything. I just could not manage. He could not go there as we had planned. I was completely broke. With 19 cows, selling the milk they produced (50 taka/litre) each day, together with the fish I managed to catch, I was pretty well off economically (Ahmed et al. 2019:910-911).[33]

The trauma that came with experiencing cyclone strikes sometimes paralysed people for years, which could put them in debt as they were unable to tend to their livelihoods. Debt collectors often claimed land or livestock from people unable to pay the instalments of their loans. In this way, natural resource stress and livelihood strains exaggerated by well-being erosion could lead to financial and social loss that triggered additional natural resource losses:

Extract 4

After [cyclone] Sidr, I became anxious. I cannot seem to relax. Especially during [cloudy and rainy] days like these/ … /. I feel the breeze coming in from the sea, and it forces me to remember. I cannot stand that breeze anymore. / … / I had a wife, two sons, and two daughters. They were my family. All died in Sidr. Everyone except me. / … / I am the only one who survived from my family. I survived, but my head and my mental well-being did not. I am not stable. When a person faces such a tremendous loss, he ends up frustrated. All my four children and my wife died. I am the only person left alive. How could I possibly be mentally stable? I have fallen apart (Ayeb-Karlsson 2020c:8)

Extract 5

These hazards keep coming back every year. Besides the mental traumas that they leave behind, the worst impact upon people is the loss of human lives on an annual basis. Money and time can reduce damages, but they cannot return a lost life. / … / Physical damage and the loss of resources that were emotionally important to us are unforgettable losses. / … / Some internal losses may also take place. / … / During the cyclones, some people get injured internally. Injured within such an important organ that he or she may face complications afterwards. They may approach doctors and seek medical treatment in secret, but some losses cannot be healed by doctors. / … / People face mental issues because of these traumas. Family problems arise as a result, and they grow larger by each day. However, when we talk about floods, it is often the economy that receives the most importance. / … / The only doctors that came to see us [after the cyclone] were [physical] medical specialists. They were not able to give mental or psychological support to the victims here. / … / We noticed that some children would bury their toys after here and there. / … / From the children's behaviour we sensed their fear. They often repeated: 'When will the flood strike again? Will I have to go [to the shelter] again then, or will I die next time? If it happens again, then please promise me not to leave me'. / … / The parents reassured their children that the flood will not come back, and that they should go back to living life in the way they had done before the disaster struck (Ayeb-Karlsson 2020c:8-9).

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32 To maintain reader flow and analytical transparency, two text extracts will be presented to justify each research finding, while additional text extracts backing up the analysis can be found in the notes.

33 **Extract 3**
It would have been better for me to have died in that cyclone. I lost my cows. I found some of their corpses in different places. Some of them were washed away. There was one cow left alive. What will I sell now? I lost my lands, so what will I plough now? I felt so helpless. Dying with the cyclone seemed better to me. I couldn't think of anything to do further/ … / That is why I had to leave farming and now I have no option but to catch small shrimps (Ahmed et al. 2019:912).

People found different ways to deal with the climatic uncertainty and erosion of well-being. Religion, for example, sometimes made it easier for people to accept the natural resource losses resulting from cyclones. Those who found a way to live with and accept the cyclone loss were sometimes psychologically more resilient to the stress and managed to avoid periods of depression, work loss and debts leading to natural resource grabbing:

> ***Extract 6***
>
> When I came back home, it was all gone. There was no sign of our home. I felt so alone. Then I thought Allah took everything from us and if he wants, he will give me back. Then the relief came and gave us food and support (Ahmed et al. 2019:910).

> ***Extract 7***
>
> When I think about why I survived that day, the day of Sidr, why I did not drown although the flood pulled me away. There is only one answer: Allah looked after me. Allah kept me safe. I am not afraid. If Allah wants to take me, he could easily do so. What is the point of being afraid? It is out of my hands just like the grief that my land went into the river. It was Allah's property, and he took it away. This is not a problem as he is the one who keeps us alive. He will make sure to feed us. If another cyclone strikes, there is nowhere to go since we lost our land on which we could have rebuilt our houses. You still have to keep your faith in Allah, and wait out the cyclones patiently in your room. What else can you do? This is our story, the story of every single person in this village (Ayeb-Karlsson et al. 2019a:762).[34]

Another response to the cyclone-induced natural resource losses was to turn to migration. Moving towards alternative income opportunities, often in cities, was a way to cope with and rebuild what had been lost in the cyclone strike. The accounts described migration to the capital, Dhaka, in search of a higher income and dreams of a better life. Many migrated temporarily with the idea of spending a few years in the city, and then returning, purchasing land and rebuilding a home with the money: "If I could buy some land and build a house, then I would go home", "We are all here to save up some money. Money that will enable us to buy a piece of land and get a house' and 'If I can arrange enough money, I will go back to my birthplace, Bhola" (Ayeb-Karlsson et al. 2020, pp. 9-11).

The increased living expenses in the cities or other unforeseen circumstances often hindered many migrants' dreams. People ended up struggling with homesickness and a desire to return home: "I do not want to live here. I want to go back to my village" and "I hope I will be able to go back, back to Bhola". As the move turned into longer-term displacement, the fragmentation of belonging and identity became more prominent: "I feel no connection to this place" and "I had to live here so obviously as a result I had to sacrifice my honour" (Ayeb-Karlsson et al. 2020, pp. 10-11). The narratives captured grief and sadness around the land and life that had been left behind:

> ***Extract 9***
>
> We lived so much better. We would grow rice and we had a large house surrounded by trees. We were a happy family with plenty of crops and land, but then it all went into the river. / … / I say [I am from] Bhola. I am from Bhola. That is where I come from. / … / Home is Bhola. If someone asks me where my house is located, I say Dhaka. Then I say that it is located at the slope of Pallabi, but if someone asks me about my home, I say Bhola (Ayeb-Karlsson 2020b:5).

> ***Extract 10***
>
> We now struggle with hunger. /…/ We have to leave our pride behind and beg for help from others. If I had stayed on Bhola Island, if I still would have my land and house there, I would be all right today. Our living condition would be better and our children would have ended up being highly educated (Ayeb-Karlsson et al. 2016:690).[35]

34 **Extract 8**
Why are there so many disasters? Because we must have left his [Allah's] path. Women are working outside the house and going here and there. This is not good. We have to return to his path. Otherwise, we will have to face the consequences. The cyclone shelter will not be able to save us then. I can feel that the weather is changing. I think it is happening because we forgot about Allah. It is the punishment of Allah. /…/ The cyclone strikes are holy creations. The same way God created man, he created cyclones. Therefore, God will decide how they will affect you. Those who have done him right, and who have followed in his footsteps will be put in safety (Ayeb-Karlsson et al. 2019a:763).

35 **Extract 11**
Life on Bhola Island is more peaceful. I think that it is better. I have lived in Dhaka for more than ten years now, but I do not like it here. Dhaka is not my place. I want to go back. I want to live in my village. For me life is better there. The village environment is way better than the environment here. In the village you do not realize when six months have passed, but here it is difficult to pass each and every day (Ayeb-Karlsson 2020b:7).

Many households sent a few family members to the city to access remittances, while the rest stayed behind. Successful access to remittances, however, depended on several factors. For example, many migrants ended up seeking employment in the garment factories that exposed people (and particularly women, children and teenagers) to verbal and physical abuse or sexual exploitation. Meanwhile, insecure living conditions in the slums and hazardous labour activities involved the risk of eviction, accidents, injuries, drugs, crime and violence:

Extract 12

> This is not our land. There are no papers or documentation allowing us to live here. If the government wants to, they can ask us to leave anytime. There is no security (Ayeb-Karlsson et al. 2020:10).

Extract 13

> After my wife got sick, I could not manage to save up any money. She needs her medicine everyday which is about 250taka [£2.50]. I cannot work due to my health issues so how am I supposed to feed her? I had to ask people I know for money, and an NGO lent me about 30,000taka [£300]. The money I borrowed from people I will have to pay back with interest. If the loan would be 2000taka then I need to pay back 2800taka. So the interest is 800taka. /…/ I cannot work so I cannot pay back my debt. I do what I can, but I only manage to pay the interest (Ayeb-Karlsson 2020b:7).[36]

This downward spiral further impacted people's access to natural resources, well-being and mobility options. People sometimes identify as immobile or trapped immediately after the cyclone strike but also after having migrated.[37] As people became more desperate, the risk of entering exploitative and unsafe working and living environments grew. Mental health issues, due to violence or psychological and sexual abuse, are widely reported in relation to the garment factories. However, other studies also link disaster displacement to trafficking and (orphaned) children being lured into prostitution. These factors all reduced peoples' chances of saving up money in the cities to access natural resources, buy land and move elsewhere. Besides this, the experiences came with direct and indirect well-being and societal impacts. Child labour, for example, immediately influences the mental health of children while also having long-term impacts upon the society through the loss of education, financial, social and legal safety nets

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36 **Extract 14**
[When we moved to Dhaka] my father could not work as he was too old. My brother therefore supported us economically. / … / After he died, my parents suffered a great deal and I had to start begging. Go from door to door. / … / [If we would have stayed] I would have been able to take care of my health. We would have our land to cultivate so our living conditions would be better. We used to have our own land so we did not have to run after people. The way of living there was good (Ayeb-Karlsson 2020b: 5).

Extract 15
My husband cannot work properly as he had an accident. He was cutting mud on a hill and got struck by a sudden landslide. There was a pipe inside the hill and it broke creating the landslide, and he fell down in a hole and was buried. His fellow co-workers removed the mud and managed to save him. They took my husband to the hospital. Now, whenever he tries to work, he faces many problems. He is in pain coming from both sides of his belly, and sometimes when he coughs, blood comes out of his mouth. (Ayeb-Karlsson 2020b:7).

Extract 16
If we would have lived in the village, our son would have grown up in a better environment than where he is growing up now. He could ruin his life here because he may start mixing with the wrong crowd, and start socializing with 'ruined' children. Then he may start taking drugs because there are so many opportunities to ruin your life in Dhaka city. In the village, there are no such options. In the village, there is no tobacco, and there is no weed or drugs (Ayeb-Karlsson 2020b:3).

37 For more details on the case studies related to cyclone-induced disaster immobility see Ayeb-Karlsson 2020c, 2020d, while urban immobility and displacement after rural-urban migration are further described in Ayeb-Karlsson et al. 2020 and Ayeb-Karlsson 2020b.

(Rashid 2013; Rezwana and Pain 2020; Haywards and Ayeb-Karlsson 2021).[38]

5.4.2 Pathway: Debt, illegal livelihoods and natural resource conflicts

The cyclone-induced loss and reduction of natural resource-based assets (such as land, water and livelihoods) sometimes increased social tension or triggered conflicts and land grabbing. Conflicts, for example, arose in relation to livelihood shifts, land ownership and access to fishing waters:

> ***Extract 17***
>
> At first the/…/family and the/…/family used to do business together, but then three people came here from Barguna and decided to take up the same business. The newly arrived said; *"You are fishing on our land and you are cleaning out our waters. Are you not going to include us in your business? If you want to do business alone we will see how well you will manage to continue the business* (Ayeb-Karlsson et al. 2016:687).
>
> ***Extract 18***
>
> They tied him up with ropes, hands and feet, so he could not move and then they started beating him up. They used wooden sticks and took turns to beat him up until he was unconscious. Then they spit paan [betel leaf with areca nut/tobacco] on him and told him to leave and stop occupying land that did not belong to him. /…/ After that they threw him in the river. If it was not for a man passing by, finding him half dead in the water and bringing him back home to us, he would have died (Ayeb-Karlsson et al. 2016:687-688).

Some explained how they had accumulated debts by borrowing money from private individuals while they were getting back on their feet after the cyclone. Others had taken out loans to purchase fishing equipment or agricultural produce that were lost in the disasters. Without the profits from fish or crops, people were left unable to pay back the instalments. Unpaid debts sometimes provoked violence or house and land grabbing by the moneylenders or pushed some to join bandits (so-called pirates) in the Sundarbans.

People often felt that the only way to recover natural resources lost in the cyclone strikes, pay back debts or to survive was through illegal means such as breaching fishing laws or regulations around conservation areas. These livelihood activities could lead to trouble with law enforcement and the Government:

> ***Extract 19***
>
> I owe a debt of another 30,000–35,000 taka to people in the village from whom I had borrowed money to deal with my loss during Sidr and after the riverbank erosion (Ahmed et al. 2019: 911).
>
> ***Extract 20***
>
> We go to the Sundarbans not because of greed but to support our stomachs. If we do not go to the Sundarbans, then what will we do to feed our family. It is not an easy task to cut wood in the Sundarbans. It requires hard work/…/ The Sundarbans is a restricted area. So, it is a crime to cut down any trees without notifying the forest department. If you cut down trees without doing so, you might be accused of having committed a crime and the forest department might file a forest case against you (Ahmed et al. 2019: 912).

Others migrated to engage in income-generating activities in the cities. Male outmigration sometimes created problems for the families left behind. Women and children became more vulnerable without the protection of the household head, and faced an increased risk of gender-based violence or sexual abuse and exploitation (Rezwana and Pain 2020; Haywards and Ayeb-Karlsson 2021).

Remittances were sometimes sporadic and unreliable, while some men even abandoned their families and never returned. Women forced into debt to pay for food and clothing got pulled into vicious cycles of dependency (Rashid 2013; Haywards and Ayeb-Karlsson 2021). In addition, working outside the household sometimes came with a social cost in rural areas where people felt that women belonged at home.

Migrants also reported increased risks of social tension, violence and conflict upon their arrival in the cities:

38 Hayward, G. and Ayeb-Karlsson, S. (2021). Seeing with empty eyes: A systems approach to understand climate change and mental health in Bangladesh. Climatic Change 165, 29. https://doi.org/10.1007/s10584-021-03053-9.

Extract 21

> We got the notice about five to fifteen days before the eviction. When they finally came here to remove us, a conflict arose. The government officials came here with the police and physically tried to remove us and started fighting the slum dwellers. We had a local political leader on our side. Her name is Dipty. She is a member of the parliament now. She stood behind us and supported us in our protest. However, the police still came here, she was arrested, and thrown in jail. The prime minister released her later on. Two people in the settlement were severely beaten by the police (Ayeb-Karlsson 2020b:4)

Extract 22

> After arriving in Dhaka, he did not find any work and got involved with drugs. He gradually went into debt to be able to buy more drugs. / … / He had to go back to the village to take care of his children. After coming to Dhaka, he chose the wrong path and got addicted to drugs. He feared that his children might get involved with drugs too [if they came to Dhaka]. He did not want for his children to go down the same path that he did (Ayeb-Karlsson 2020b:7).

Part of this related to the informality of the settlements where slum dwellers were evicted and deemed to illegally occupy land. Other processes related to unemployment, debt, substance use and/or crime.

5.4.3 Pathway: Natural resource strains, gendered (im)mobility and marital exchange

Gender roles did not only influence people's migration options, but they also played an important part in people's evacuation behaviour and access to natural resources. The gendered evacuation process passed through various natural resource-dependent layers for women and men. Women sometimes described feeling responsible for the house, belongings, livelihood tools and livestock, which made them want to stay and wait out the cyclones at home. People believed that the female presence protected the home and access to natural resources. With women's evacuation to the shelters, the home and its value was at increased risk of being damaged or lost:

Extract 23

> I cannot just leave my house that easy. I should try to stay until the end. I have a responsibility to my household, to my cattle, and my furniture (Ayeb-Karlsson 2020a:14).

Extract 24

> I told my wife to go to the cyclone shelter, but she would not reason with me. / … /Not even when the storm increased and things turned from bad to worse. Her main concern was still the cows. / … / As the water level was rising fast, we did not have much time/ … /my son filled a bag with money, 30.000taka or so, and attached it to his lungi [traditional male clothing]. We headed off towards the cyclone shelter, my wife, my two sons and I, but as we got outside, we realised that we would never be able to make it. It was too far and the water was flooding with an enormous force. / … /At one point, the stream caught hold of the moneybag. My son let go of his mother's hand to try to save the money that was being pulled away in the water. When he let go of her hand, the force was too much for my younger son to handle by himself. He lost hold of the grip around her hand. The water was too deep, its force too strong. We caught up with each other around a big tree. '*Where is your mother?*', I asked. 'I lost her', he responded. We found her body the next morning (Ayeb-Karlsson 2020c:7).

Another gendered immobility aspect was the risk for unmarried women and girls outside the home. Evacuating or seeking shelter could come with greater natural resource, social and financial costs. This ranged from rumours, damaged reputation and honour, to verbal, physical and sexual abuse, which would all make it more difficult for them to marry. As marriage was a financial transaction through the dowry system, such an incident could put the whole family at financial risk and force them to give up land:

Extract 25

> Unmarried women face problems in the shelter. Young men sexually harass or 'tease' them and they cannot maintain their privacy (Ayeb-Karlsson 2020a:18).

Extract 26

> The girl is educated, even though the villagers are not. She knows how the early warning system works and how to prepare for the cyclone strike. She informs the villagers of what they need to do, that they need to go to the cyclone shelter, and of all the necessary steps before going there. She helps the children, the elderly and the pregnant to the shelter. She also advises them to bring

> their valuables. In the end, those who are strong go to the shelter. The girl tells them to bring dry food, so that they have something to eat later on, and matches to light a fire and stay warm. / … /When the girl gets to the shelter, she tries to find a safe place where no boy can harm her. As she is educated, she has told everyone to please make sure that they are safe. '*If you feel that you are safe in a place, then do not move, or try to go somewhere else*' she says. This is also what she tells her parents. / … /Anything can happen in the cyclone shelter, boys and men can try to harm her by grabbing hold of her hands, and by covering her mouth [so that she cannot scream for help]. The boys and men are from different places, they try to disturb her although she brought her parents with her for her protection. She already knows that women need to be careful of this. / … / The girl decides not to tell anyone what happened as she is afraid of losing her honour. She thinks to herself: I was an educated girl who was planning to create a better life for myself, but now, because of this, all is ruined. She decides that she does not want to live anymore, and kills herself by drinking poison (Ayeb-Karlsson 2020c:6-7).[39]

Not only are women and girls impacted by the gender system, but children in general. For example, women who lost their husbands in a cyclone strike sometimes had to abandon their children to be able to re-marry. Similarly, unplanned pregnancies or abandonment of young women being sent to Dhaka for work and remittances could take them down the same path:

> ***Extract 28***
>
> In most cases, underaged young wives who lose their husbands during the cyclone strikes re-marry. The women leave their children behind in order to re-marry. These children often grow up choosing the wrong path in life, and start doing bad things for a living (Ayeb-Karlsson 2020c:7).

> ***Extract 29***
>
> It is very rare for a girl to go to Dhaka alone. One girl in a hundred perhaps goes alone. What generally happens is that after some time her character changes. She ends up marrying someone and forgets about her family. If a girl moves to Dhaka for work, she should keep in mind that she has to send money to her parents, and that she must wait to marry until her parents want her to do so. If she forgets this and gets into a relationship with a man, marries him and starts a new family, she may suffer in the long run. Girls often meet men in the garment factories and start a relationship, but the husband may leave her even after she has had his child. This is the punishment for marrying someone without knowing enough about him. The first six months or so the husband may behave well, but then, what generally happens is that he changes. It is the girl then who has to suffer. In this situation, she can no longer go back home to her parents – she will have to work to provide and care for his child. She will have to work alone to support herself and her child. Perhaps she keeps her child somewhere under a tree while she works, and when the child cries, she comes running to calm her down. That is what her life has become miserable. If she only would have listened to what her parents said and kept to her work, she would not have to face such a reality. Though she only cared about herself and ended up ruining her life instead. / … /A man can surely get married again, even a girl if she is a dreamer. She could get married to another man too. Though it is the child who suffers the most in this kind of situation. A mother can re-marry with the child, or she can leave the child behind. / … / The mother got another husband, the father got another wife, but what is there for the child? What did she get out of all this? Shame and hatred! This is why the child suffers the most (Ayeb-Karlsson 2020b:6).

Child marriage was described as a common coping mechanism for families to deal with cyclone-induced natural resource strains and losses. Marrying off children could help reduce household expenses, increase food security and open the doors to disaster relief. Dowries were generally lower for girls than for adult women, and were reported to go down during the cyclone seasons. This was aggravated by closures of schools after the cyclones. Marriage was therefore used to protect girls from sexual exploitation during and after disasters. However, rushed child marriages also further exposed girls to verbal, physical and sexual violence including human trafficking. Adding to this, the dowry system itself could be a cause of social tensions (Ahmed et al. 2019; Rezwana and Pain 2020; Haywards and Ayeb-Karlsson 2021).

39 **Extract 27**
It is not right [for unmarried women to go to the shelter] because it could create problems. / … / I do not like women going to the shelter. It just does not feel right. Wherever they go, things happen (Ayeb-Karlsson 2020c:6).

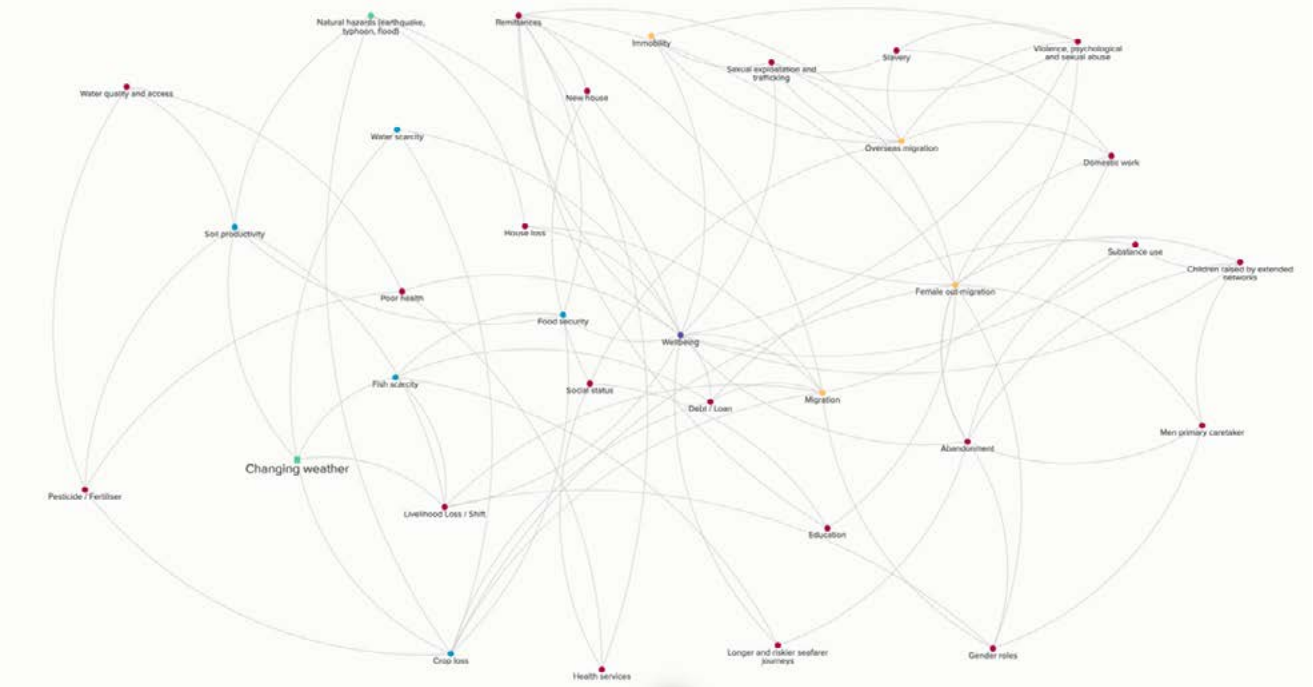

Figure 26. Migration and immobility impacts of natural resource degradation in the Philippines based on empirical connections from unstructured interviews and storytelling sessions organized by the authors. Green dots represent the environmental impacts, blue ones represent natural resource-based factors, red dots are human and social factors, yellow ones outline the (im)mobility outcomes and finally the purple dot indicates well-being.

In general, women and children were reported to struggle more with post-disaster natural resource degradation in Bangladesh. For example, women and children more often face malnutrition, stress, anxiety and domestic abuse after a disaster strikes. Besides the disaster-induced trauma, the natural resource shocks trigger difficult feelings and experiences that related to gendered labour division. Women who were unable to secure food and water felt that they did not perform their gender roles, while men facing land and livelihood losses explained how this made them feel less like man (Rezwana and Pain 2020; Haywards and Ayeb-Karlsson 2021).

5.5 Natural resource degradation and (im)mobility in the context of slow-onset events in the Philippines

Several studies in the Philippines research natural resource degradation and (im)mobility in the context of slow-onset events (Acosta et al. 2016; Chandra et al. 2017). While certain geographical areas, environmental impacts and (im)mobility narratives are overrepresented in the current literature, others are lacking.[40] The United Nations Framework Convention on Climate Change (UNFCCC), Internal Displacement Monitoring Centre (IDMC) and the Platform for Disaster Displacement (former Nansen Initiative) agree on the need for more knowledge about the impacts of slow-onset environmental processes (UNFCCC 2012, 2018; PDD 2018; IDMC 2019).

Slow-onset processes, such as changes in rainfall, temperatures and sea levels, can decrease land productivity and access to and quality of water resources – with implications for (im)mobility. Sea level rise, for example, is estimated to result in devastating natural resource losses in the Philippines through its impacts on fresh water, soil quality and coastal erosion that could contribute to both migration and trapped populations (Bell et al. 2021; Cruz et al. 2017; IPCC 2018; Laurice Jamero et al. 2017; McMichael et al. 2020; Philippine Atmospheric, Geophysical and Astronomical Services Administration 2018). Many of these pathways will be expanded on in this section (see Figure 26).

40 See, for example, the geographical review of the environmental migration literature by Piguet et al.2018, the review of the use of trapped populations by Ayeb-Karlsson et al.2018 and the literature review on slow-onset events and human mobility by Zickgraf 2021.

5.5.1 Pathway: Creeping natural resource changes, (im)mobility and mental health

Overall, the narratives of people in origin areas for rural migration focused more on the impacts of natural resource strains than in migration destination areas. This was mainly because people in rural origin areas tended to have more agricultural- and fishing-based livelihoods, while livelihoods in urban destination areas were less natural resource-based.

Those who decided to migrate in response to natural resource and livelihood strains often moved towards urban centres due to their income opportunities: "There are fewer migrants here in the Visayas than in Luzon. Those areas are more urbanised and there are many productive centres with companies that serve as major migration destinations" (Ayeb-Karlsson and Uy 2021).[41]

People described direct and indirect slow-onset impacts on natural resources as influencing their decisions and desires to move, and subsequently their well-being. Increased temperature, for example, was described as a factor that impacted people's choices to migrate: "It is extremely hot here. It is cooler there. You would find it difficult to work here because it is so hot. Over there, you will not", "When the weather changes so do the mood of people" and "It is colder there so it is nice to sleep" (Ayeb-Karlsson and Uy 2021a). High temperatures reduced soil and water quality, and made it difficult to work outside due to potential physical and psychological health impacts over time. The heat also disrupted sleep and quality of life:

Extract 30

> I grew up with parents who were farmers. Our livelihood has always been farming. My father would harvest sugarcane while I helped load it onto the truck to be transported. That has been my main role ever since. There were days when it would suddenly start raining during a hot day after working under the sun for hours. We often get sick and suffer from fatigue, body pains and flu [due to the changing weather] (Ayeb-Karlsson and Uy 2021b).

A common narrative related to how slow-onset processes impacted the natural resources required to carry out livelihood activities and thereby reduced income and food sustainability. Water insecurity, due to unreliable rainfall and increased temperatures, could lead to reduced crop harvests and crop losses that pushed people to migrate in search of alternative income opportunities in the cities: "Life here is all about farming. However, because of the unpredictable weather we experience crop failure. That is why we move" and "It is difficult to find money in the province. If your parents are farmers, you may need to wait three months to be able to buy yourself a treat" (Ayeb-Karlsson and Uy 2021a). These movements could be permanent, temporary or seasonal:

Extract 31

> The changing weather pattern is a factor for migration. People used to harvest four times a year. Now, they can only harvest once a year. The high temperature leads to crop failure. /.../ Our livelihood is also seasonal. After the sugarcane harvest, people will move to find another job since there are no alternative jobs here. These challenges push people to migrate to urban centres for a stable source of income (Ayeb-Karlsson and Uy 2021b).

Despite the increased income opportunities, many described how other elements in the new environment could influence migrants and the family members left behind – "Life is difficult when you are far from your family" (Ayeb-Karlsson and Uy 2021a):

Extract 32

> There is an overflow of food in the countryside compared to here in the city. I often experienced hunger and difficulties when I had no money, but God was good, merciful and ensured that my needs were met. I also had to work hard to provide for my needs. /.../ Migration greatly affects a person in the way that you have to adjust with regard to the people in the new society or the new place, as well as how you earn money and make a living. It affected my well-being. I was very thin back then and experienced depression and some problems because of the changes (Ayeb-Karlsson and Uy 2021b).

41 Ayeb-Karlsson and Uy (2021a). Island Stories: Mapping the (im) mobility trends of slow onset environmental processes in three island groups of the Philippines. Working Paper. Forthcoming

Extract 33

> It greatly affects my relationship with my family since I am always away. There is a saying among us seafarers that "when one gets onto a ship, it is like leaving half of your body behind". It is difficult because your thoughts are always with your family that was left behind. It was one of the major factors that affected my work on the ship as extreme focus is required (Ayeb-Karlsson and Uy 2021b).[42]

Upon their arrival in the cities, migrants often settle down in informal settlements where the living conditions represent new risks. This includes environmental hazards such as poor housing and sanitation, as well as crime, drugs and violence that further erode people's well-being:

Extract 35

> When we were in Gonzaga [an informal settlement], our house had no bathroom and the houses were located very close to one another. We experienced a fire that greatly challenged us as we had to try to escape through the very narrow pathways. /.../ They have also reported drug-users in that area. Houses often get raided because of the use of illegal drugs. There are thieves being chased by the authorities. I told my husband to find a safer place to live for our family. If we remain in such a place, it will affect the way that my children grow up. In the worst case scenario, they will become just like them (Ayeb-Karlsson and Uy 2021b).

Extract 36

> A friend invited me to look for a job in Manila. I lived in Quiapo and worked as a dishwasher. I also worked other jobs such as delivery and driving. I was eighteen then. After three years, I went back to Isabela because I was being led astray by Manila due to the pressure and trouble in the city. I got involved in a gang. It was violent back then because gangs would challenge each other (Ayeb-Karlsson and Uy 2021b).

Other people felt that migration was not an option for them to deal with the natural resource strains. Some people did want to leave their homes and livelihoods for a new life in the city. The elderly, for example, often felt that they could not move. They also expressed being more afraid or hesitant of the changes that came with the migration process: "As a 65-year-old, I wanted to return to farming, but with climate change, the weather patterns do not match the planting season. Rain and intense temperatures disrupt the farming. I am forced to stay due to old age. I can attempt working on the farm, but it is not enough" (Ayeb-Karlsson and Uy 2021a). Their livelihood activities and land ownership often formed an important part of their identities and they felt a deep emotional connection to their land and homes:

Extract 37

> I would not want to leave. I was born here and I choose to stay here. It is better here. You can simply plant and do backyard gardening so that you can eat. You can go to a nearby hill to get coconuts. However, when you are in the city it is hard. You have to pay for your vegetables and coconuts [and other needs]. It is not like here where one just plant crops whenever needed. /.../ In the city, the air is polluted due to the smoke but here the air is fresh. I like it better here. It is already polluted over there (Ayeb-Karlsson and Uy 2021b).

Extract 38

> I do not know of anyone here who has given up farming due to the current conditions because this is the only thing they have to depend on. /.../ Land is important for people. Even though losses occur, people continue to farm. They will not think of selling their land except during an emergency when there is no other way but to pawn their land (Ayeb-Karlsson and Uy 2021b).

Land ownership or investments that constituted livelihood activities, such as farming or fishing equipment, were examples of major immobilizing factors. Farmers sometimes took out loans to pay for seeds, irrigated water, fertilizers, weeding and agricultural labour, while planning to pay these back with the harvesting profit. In the event of crop loss or reduced harvests, many ended up in debt. This greatly impacted their well-being and sometimes even pushed people to become fugitives: "The water from above does not sustain the farms below. That is why people are forced to pawn their lands", "Debt. People go into hiding because of it" and "They may migrate because of unpaid loans that target them as wanted" (Ayeb-Karlsson and Uy 2021a).

42 **Extract 34**
I needed to be both a mother and father to my children. You have to take on your husband's responsibilities. You have to make sacrifices. Sometimes money is not sufficient so I sell 'halo halo' (iced dessert) in my house during hot days to ensure an additional income. I also have a small retail store (Ayeb-Karlsson and Uy 2021b).

The migration narratives mainly captured people moving alone, while household movements were not as common. Women often moved abroad (through the overseas work schemes) or to the cities for domestic work: "They work in the city as domestic helpers, but they return here from time to time" and "Some wives have gone to work as domestic helpers abroad. The women here, even at 15 or 16 years, take up such domestic work" (Ayeb-Karlsson and Uy 2021a).

Extract 39

> I hope to be able to work and help my mother, and especially now that my father is gone. If there was an opportunity, I would. I want to go abroad because of the money one can earn there. I want to renovate our house and I want to build a bigger store. I want to save money for our children, for their future. At the same time, if I were to leave, I will not be able to take care of my children (Ayeb-Karlsson and Uy 2021b).

However, some felt that they were unable to leave their families, and particularly children, behind. In this sense, family and caretaking responsibilities could be an immobilizing factor: "I do not want to leave my children" and "You must spend time with your children and family. Your guidance and teachings cannot be bought by money" (Ayeb-Karlsson and Uy 2021a).

Extract 40

> She went to Hong Kong to work as a domestic service helper, and left her children with their grandmother. While abroad, she sent money so that her children could go to school. However, her oldest son started resenting her absence after some time (Ayeb-Karlsson and Uy 2021b).

Extract 41

> I miss my sister in Manila. I also feel sad when I see how my niece misses her mother. My sister left her baby in Midsayap when she went to Manila for work. Her being away has already caused a strain in our family. My brother's wife always has something to say to my sister, judging her for leaving her child with us to work in Manila. It is difficult to see my niece without a mother (Ayeb-Karlsson and Uy 2021b).[43]

Interestingly, those expressing the strongest oppositions to leaving children behind were often the children of parents who had migrated during their own childhood. They had first-hand experience of the impacts of the abandonment and lack of a parent (often a mother) on well-being, as well as witnessing the struggles of those left behind to care for them.

5.5.2 Pathway: Unsustainable resource management, (im)mobility and erosive coping[44]

The narratives also described how natural resources degradation due to slow-onset events could lead to unsustainable natural resource management. These mainly related to land and soil degradation that people related to the increased temperatures and lack of rainfall. In the storylines, it was explained how short-term erosive coping mechanisms (involving increased use of fertilizers in response to reduced soil quality) had degraded the land even further. The combination of climatic changes and unproductive soil resulted in crop failure and food insecurity: "The land is unproductive because of the inorganic fertilizers" and "If the land is degraded it can destroy the forest and cause crop failures and food shortage. Heat leads to crop failure, while the use of fertilizers damages the land. Changing climate (longer dry seasons and shorter wet seasons) result in reduced harvest" (Ayeb-Karlsson and Uy 2021a).

In the shorter term, it was difficult for farmers to avoid fertilizers as the soil quality and productivity had been negatively impacted by the changes in temperature and rainfall. The use of pesticides and fertilizers made uncertain agricultural conditions slightly more controllable for the farmers. This was because they increased the harvest produce and stability, while

43 **Extract 42**
My mother is based in California, USA. She got married, her second marriage after our father died, to a foreigner. When my mother migrated to America, I was already working and so was my older sister. She was working in Dubai. The ones who were affected the most by her leaving were our two younger brothers. We took responsibility for them and provided support on behalf of our mother (Ayeb-Karlsson and Uy 2021b).

44 In this chapter, 'erosive coping' refers to a situation where people are forced "to dispose of assets, undermine their nutrition and health, and generally erode their ability to survive" (Cannon and Muller-Mahn 2010:2), in order to deal with natural resource and livelihood shocks. These immediate responses to food and livelihood insecurity are often at the expense of people's risk-management capacity in the future (de Waal 1989; Davies 1993; Ellis 2000; Opondo 2013; Rademacher-Shulz et al. 2013).

reducing the financial investments as people avoided having to pay for certain labour activities (such as weeding): "If we do not use fertilizers, our land will not be productive" (Ayeb-Karlsson and Uy 2021a):

Extract 43

> Farming is really hard and the labour problems add to it. As others have migrated, labourers do not come here. If there is one, he will be very demanding. Those who stayed are those with property. They are stable. However, it is not only about being stable, you also have to mechanise [your farming processes]. We have no money to buy the equipment so we bear the hardship. We have to continue hiring labourers (Ayeb-Karlsson and Uy 2021b).

In the longer term, however, people acknowledged that such soil treatments (particularly herbicide or ammonium sprays) further damaged and reduced the productivity of the land, while also negatively impacting other natural resources. Livestock sometimes died from feeding off treated grass, while water sources were and surrounding forests became polluted:

Extract 44

> I noticed that the land was more productive before. The excessive use of chemicals has made the soil bad. It has lost its fertility and the water has become polluted. For example, the Kabacan River in the past was clean and you would not be afraid to take a bath. Now it is so polluted that people get skin rashes from bathing in the river. When we were children, we used to take baths in the river and I never once experienced any skin rash or health problems. In this generation, I have noticed a lot of cases where our students have skin rashes because of the river (Ayeb-Karlsson and Uy 2021b).

In addition, agricultural investors avoided the area as they were aware of the struggle farmers faced due to the land degradation. This made life as a farmer increasingly difficult, and it made people feel as if outsiders had given up or saw no future for their village: "Financing schemes are usually not provided to people here because they do not trust us. This is because the land here leads to crop failure. Adding to this, there is drought and unpredictable climate" (Ayeb-Karlsson and Uy 2021a). The situation also drove down land prices, making it more difficult for landowning farmers to sell their land and move elsewhere.

In the conversations around sustainability, people expressed awareness around the importance of living in symbiosis with nature and how human activity, such as cutting down trees for charcoal and carbon emissions, was partly behind the changing climate: "We see climate change and this is due to people cutting down trees for charcoal" (Ayeb-Karlsson and Uy 2021a).

Extract 45

> In the city, the high carbon emissions from vehicles destroy the ozone layer. The garbage thrown everywhere by people who lack discipline also causes flooding. This is the reason why we cannot blame God whether he is the one who allows these [disasters] to happen because it is our own doing (Ayeb-Karlsson and Uy 2021b).

The situation resulted in people wishing and attempting to migrate to urban areas but also to areas that could provide them with richer natural resources. Those attempting rural-urban migration explained how social networks, livelihood opportunities and housing were important criteria for determining where to go. People often followed relatives or friends who had already settled in the cities and could host them or even refer them to their employers: "Having no house to stay in or migrate to is another problem. More so without family members to shelter us" and "You also cannot migrate easily when you do not have a job waiting for you there" (Ayeb-Karlsson and Uy 2021a). Meanwhile, those seeking better access and increased quality of natural resources mentioned land and water as elements that people would like to move towards if they had the opportunity:

Extract 46

> Land in Labon has become less productive due to loss of trees, frequent spraying of fertilizers, less rain and intense temperatures. Since sugarcane farming is the major source of livelihood in the area, land productivity is a factor for people to migrate in search of more fertile land (Ayeb-Karlsson and Uy 2021b).

Extract 47

> The farmers who can afford it installed deep wells, but not farmers like us. We have almost nothing. Our farming is rain-fed since we have no irrigation system. We have no water supply. We live on prayers during these times. Once you plant, you start praying. /…/ Last year, it was hot and dry already in February. We have experienced severe

> droughts perhaps three or four times. This is the reason why our debts keep piling up. It is hard when you only get to harvest once a year and all expenses are covered by loans (Ayeb-Karlsson and Uy 2021b).

Natural resource-linked migration often went along with the desire for increased technology to better access these natural resources, such as irrigation systems and agricultural machines through financial investment: "Regarding agricultural problems, we are planting now. Most people here are farmers. However, in other places they can plant rice several times [a year] because they have functional irrigation systems. Here, you would have to build your own well", and "Technology better supports the agricultural activity [there]. There is a need for irrigation, water pumps or everything that farmers need here" (Ayeb-Karlsson and Uy 2021a).

Natural resource-linked migration often went along with the desire for increased technology to better access these natural resources, such as irrigation systems and agricultural machines through financial investment

Side box 5: Slow-onset climate change and (internal) migration

Extract from report commissioned by the German Agency for International Cooperation (GIZ), Philippines

A recent study supported by the German Federal Ministry for Economic Cooperation and Development (BMZ), through the German Agency for International Cooperation (Deutsche Gesellschaft für Internationale Zusammenarbeit - GIZ) global programme Human Mobility in the Context of Climate Change (HMCCC), contributes to the discourse on climate change and (internal) migration in the Philippines by correlating census migration data with longer-term and more recent climate change indicators at the municipality level. The study found that, while most temperature and precipitation changes in the long term (12 years prior to migration) had no visible impact on migration rates, drought events had a positive correlation with outmigration. Additionally, more recent (one to three years prior to migration) and more extreme temperature, rainfall and drought events had a stronger positive correlation with outmigration across all ages. Moreover, drought events especially contributed to the outmigration of young and skilled agricultural workers in affected areas (Weinreb et al. 2020).

Another report commissioned by the BMZ through GIZ HMCCC also elucidated the climate-migration impact chain, which examines the particular effect of slow-onset processes on ecosystem-dependent livelihoods, food security and people's well-being through participatory research methods (GIZ 2020).

Individual and household vulnerabilities contribute to people's decision-making on migration (United Nations 2020). As shown in the examples above, landowning households often choose to stay and apply coping strategies to adapt to slow-onset impacts due to attachment to land and place. On the other hand, poorer and more vulnerable households often turn to seasonal migration to diversify livelihoods. However, not all coping strategies are sustainable long term or improve people's well-being (GIZ 2020). Moreover, slow-onset climate change impacts can slowly erode people's adaptive capacity and create "trapped" populations in the long term.

A 2019 report from the Task Force on Displacement (TFD) summarized the state of the knowledge on how slow-onset events contribute to displacement and identified pathways through which slow-onset events become disasters:

1. Slow-onset events decrease ecosystem services and can disrupt livelihoods. Over the long term, this can lead to unsustainable ecosystem-dependent livelihoods and acute food insecurity, which cause displacement or forced displacement.

2. Slow-onset tipping points can become disaster events, which can cause displacement. For example, when gradual sea level rises become a flooding event that results in loss and damage.

3. Slow-onset events erode the capacity of communities and ecosystems to respond to a subsequent disaster, and can push populations to be displaced, migrate or become "trapped".

4. Slow-onset events act as a "threat multiplier" that can exacerbate other drivers of displacement and migration including economic, political or social factors.

Additionally, slow-onset processes and impacts are difficult to predict and assess for loss and damage because they are spatial and context specific (Pereira et al. 2019). As the results from studies show, increased temperatures, extreme rainfall and drought events have contributed to declining productivity in agriculture, and correlate with outmigration from affected areas. This points to the need for rural development and climate change adaptation policies that tackle livelihood resilience and food security, as well as disaster risk mitigation and preparedness, to mitigate displacement and forced displacement. Furthermore, slow-onset processes not only affect livelihoods, but also impact well-being and social relationships and exacerbate inequalities. Thus, it is important to monitor slow-onset processes and their impacts on people's vulnerabilities and adaptive capacities, and provide "early warning systems" before these become disaster events.

5.5.3 Pathway: Overseas migration, remittances and other social effects

A prominent part of people's storylines related to those having migrated overseas either through marriage or by taking part in the Overseas Filipino Workers (OFW) schemes: "Migration to countries in the Middle East such as Qatar, Bahrain and Saudi Arabia is temporary. Our migrant relatives only work in these areas because of the Overseas Filipino Workers (OFW)" (Ayeb-Karlsson and Uy 2021a). Migration to the Gulf, such as to Qatar, Bahrain, United Arab Emirates (UAE), Oman and Saudi Arabia was mainly due to the work schemes and represented temporary moves to access remittances, while more permanent migration destinations (often through marriage) included Australia, Japan, Hong Kong, Singapore, United States, Canada and Europe (particularly the United Kingdom and Germany).

It is important to acknowledge that overseas movements were rarely immediate responses to natural resource strains. However, the migration trends in the Philippines often passed through several steps (such as from rural-urban, to urban-urban then to urban-international, which was confirmed by Paul 2011, 2015) where international movements were important to access remittances and new natural resources back home (by purchasing land, for example). A person sometimes migrated from their village to a city in the region due to natural resource degradation, continuing from there to Manila, and from the capital to abroad. The ties with the origin sites and positive or negative impact of overseas migration on those left behind were important elements in people's ability to cope with the natural resource strains.

Remittances could improve a household's situation and opened up opportunities for the family back home to purchase land, make agricultural or fishing related investments, build a new house or open up a business that provided livelihood opportunities that depended less on natural resources: "Those working abroad specifically in Taiwan, Dubai and Qatar remit a lot of money to their families. Over the years, they get to save up this money, buy their own land and have new houses built" (Ayeb-Karlsson and Uy 2021a).

More temporary labour-focused overseas migration tended to result in increasingly stable remittances, while relatives who migrated overseas permanently sent fewer remittances or none at all. This can be explained by the attempt to return home, as well as closer family members being left behind (such as partners and children). These circumstances made people want to invest more in their homes and the society, but not all temporary overseas migration resulted in remittances and positive impacts for the migrants or those left behind: "The life of overseas workers is not as easy as it may seem to be. We have to be more understanding of them and we should not expect them to send remittances regularly" (Ayeb-Karlsson and Uy 2021a).

Extract 48

> Almost all women who left to work as domestic service workers do so to help their family. If they stayed, they would be totally dependent on the income of their husbands – if there is any. If they go abroad and work as domestic service workers, they know that people will look at them differently since they will be able to buy a house and land, and have an additional source of income apart from their husband's. People see them as well-off or rich without realizing the struggles that they have to go through abroad to get there (Ayeb-Karlsson and Uy 2021b).

The recruitment for overseas working schemes did not only take place in Manila, and recruiting offices were sometimes set up in regional city centres. People explained that recruiting mainly involved domestic work for women and construction work for men. The Gulf countries were the most common migration destinations. As part of the recruitment, the expenses for passport, visa and airline tickets were generally written into the labour contracts and purchased by the company. In this way, the migrants often began their contracts by working off or paying back these investments that could take months. In extreme cases, people even faced human trafficking, slavery, prostitution, abuse and violence or other criminal activity (Chandra et al. 2017; Guth 2010). Despite reports indicating that the social protection and labour laws have improved, and therefore now protect vulnerable migrant workers better than in the past, the research sessions included various migrant experiences describing such events:

Extract 49

> I complained to the Overseas Workers Welfare Administration (OWWA) office in Davao over their inaction in the case of my daughter. She was abused by her employer in Jeddah. She was kept in her room for a week without food. She could have died. She was also not given a salary for two months. Now she is under the custody of her

recruitment agency after OWWA demanded that the employer release my daughter through the recruitment agency (Ayeb-Karlsson and Uy 2021b).

This raises an important point around how human mobility can easily turn into a state of immobility, and that (im)mobility processes are temporary, flexible and constantly changing. An individual can move, be mobile or a migrant one day, only to find themselves displaced, immobile or trapped the next (see also Ayeb-Karlsson et al. 2020 on rural-urban (im)mobility changes).

Another feature of people's mobility experiences was the way that international and internal migration could increase the social value of the migrant, as well as the household and social network left behind. This increased social value could be linked to new land ownership or by allocating part of the remittances to improve agricultural, fishing or public development (schools, churches or infrastructure) of the home village. In addition, the migration experience itself could increase people's social status: "You are considered to be famous when you are from Metro Manila", "People in the province think that being in Manila is like living with gold" and "People in the province get envious when they find out you are from Metro Manila", but that did not mean that everyone would consider moving abroad "Abroad is too far for me. I could not imagine that" and "I do not imagine going abroad, or even to Mindanao, because I do not know anyone there and I do not have money for transportation" (Ayeb-Karlsson and Uy 2021a).

Extract 50

You seldom see people from the city migrating to the countryside. Most of the people who migrate are those coming from rural areas due to the following reasons. First of all, more job opportunities. There is also this mindset in the countryside that if you are a farmer, you are labelled as poor or having low status. Secondly, a majority of the people in the countryside want to have a better and easy life. Teenagers want to change their skin tone and physical appearance to be able to show off to others in the rural areas. Finally, in order to have a stable source of income people migrate (Ayeb-Karlsson and Uy 2021b).

Extract 51

The influx of migrants to NCR [the Manila region] reflects the poor regional planning and failed countryside development and educational opportunities. Agriculture is viewed as having lower status, and it is often associated with poverty. People coming from the provinces are therefore considered traditional and behind (Ayeb-Karlsson and Uy 2021b).[45]

On the other hand, those migrating to flee debt, social tension and crimes back home in the villages experienced a negative downward spiral where their social status decreased instead. Natural resource degradation, poverty, debt and illegal activities were described as closely linked. This was because people facing natural resource strains could be pushed into poverty and debt that then forced them to commit crimes or run away: "Those who have done something wrong and are in hiding move to another place" and "You will not get a high salary with low education. It connects with poverty because you will be forced to commit crimes. This will worsen poverty. You have become a criminal /…/ If you have committed a crime, nobody will feed your family. As nobody supports your family financially, there will be no food. /…/ When you have become a criminal, there will be gossip. People gossip about you being a criminal. That you are in jail. It is like pollution because it feeds more gossip. You have become polluted by people. To them, you are already stinky. You are filthy" (Ayeb-Karlsson and Uy 2021a).

Corruption and poor transparency in public authority processes can also protect those escaping the law as long as they are prepared to pay. This made certain informal settlements in the cities more dangerous than others. People therefore sometimes moved in between settlements in the city (or attempted to go abroad) to increase their living environment and quality of life: "If you commit a crime here you can get

45 **Extract 52**
Are migrants better off after they make it to Metro Manila? Most of the migrants that come have low educational background, and automatically become part of the informal sector. They are often looked down upon because of their class, ethnicity, gender and more unless, of course, they come from families who are well-off. They may also face discrimination or resentment from the Tagalogs because of the Imperial Manila stigmatization. At the same time, migrants are viewed by people from their places of origin as having higher status, being successful, having access to cash and as being consumption driven among other things (Ayeb-Karlsson and Uy 2021b).

away with it as long as you are rich", "People leave, for example, those living in informal settlements move to find better living conditions far from thefts and fires" and "People migrate when they disagree with the laws and regulations in place. The law is better elsewhere. Here, even when you are a convicted felon, you can still run for office. That is not possible in other places as you automatically get disqualified when you have a criminal record. There is less harassment, discrimination and more acceptance of the LGBTQ people abroad" (Ayeb-Karlsson and Uy 2021a).

Extract 53

> There are socioeconomic power relations between urban and rural areas, and original inhabitants and migrants. Migrants are being socially excluded because they have no connection with the original inhabitants and with the place. As a result, they have no or limited access to social services, and it is difficult for them to enter the formal sector. For this reason, migrants strategize in building links or bridging capital. They gradually assert themselves so that they can be integrated into the system. You must have been able to observe for yourself how aggressive the migrants in Metro Manila are? (Ayeb-Karlsson and Uy 2021b).

One final major natural resource factor feeding into (im)mobility trends and wishes is the way that political, religious and tribal conflicts (often over land) shaped when, how and where people migrated. The Mindanao situation, in particular, is important to understand from the history and governance behind its natural resource management. This includes the changes in land ownership or land grabbing that took place through the resettlement programmes that began in the 1920s. The Government then relocated poor landless Christians from Luzon and the Visayas to the Muslim area of Mindanao. These are historical events that still feed into the ongoing political and religious conflicts (Chandra et al. 2017; Mialhe et al. 2014; Tigno 2006).

Extract 54

> I stayed in Manila and tried my luck there. I applied for a job as a saleslady but they would not accept me because I am Muslim. They have a prejudice against Muslims, who they believe are not trustworthy (Ayeb-Karlsson and Uy 2021b).

People were often forced to flee these conflicts or to give up land, crops or livestock to rebel groups on top of their struggles with natural resource degradation: "Armed conflict and unclear land rights have negatively impacted us. /../ For example, people escaping criminal offences influence the armed conflict. Meanwhile, the unclear land rights and ownership disputes add to the tension and conflict", "Those who relocated during the conflict are in Laak where they are now working" and "Another reason could be that people are caught in an armed conflict. Especially now that rido [clan conflict] is still in place. We have experienced this. There was a time when those who were from the outside transferred here, and those living here had to move out". These forced movements also influenced people's place- and emotional attachment to new people and homes:

Extract 55

> Life was good in our tribal land. I do not think that we will make it if we were to stay here permanently. We were born there and our livelihoods are there. There is no question that we will go back there. That is why we call on the Government to respect our culture and allow us to go back to our community free from military aggression (Ayeb-Karlsson and Uy 2021b).

Extract 56

> Staying in the evacuation centre is a different kind of hardship for us. Living in the city means that you must always have money to meet your needs. In the mountains, we get things for free, such as our food. However, even if it is hard for us to live here, because of what we fight for and believe in, we will continue to live here and do what we can. We only want the best for our community and that the younger generation continues to receive education through the community school. We want our rights to our ancestral lands and protection of the Pantaron Range (Ayeb-Karlsson and Uy 2021b).[46]

46 **Extract 57**
Our seeking refuge here is not a simple matter. Our evacuation is a historical move to fight for our tribal lands. We are in this evacuation centre to continue the education of our children. For a parent, it hurts to think that the Government itself closed our school. They did not even give a peso to build our school. As leaders of the community, we have an initiative to build a school here so our youth can learn their principles and rights, and the laws pertaining to their rights as children (Ayeb-Karlsson and Uy 2021b).

Extract 58
I identify myself as a Monobo, a Lumad. If I do not accept this about myself, I would feel incomplete. /.../ I do not get affected [by the bullying] because I have already reconciled with myself and I will not be swayed easily by others' opinions. I need to have confidence in myself. My peers now would think before they say something to me. My experiences before were difficult because I was younger. I did not know how to defend my tribe and my roots, or how to express pride in my being a Manobo (Ayeb-Karlsson and Uy 2021b).

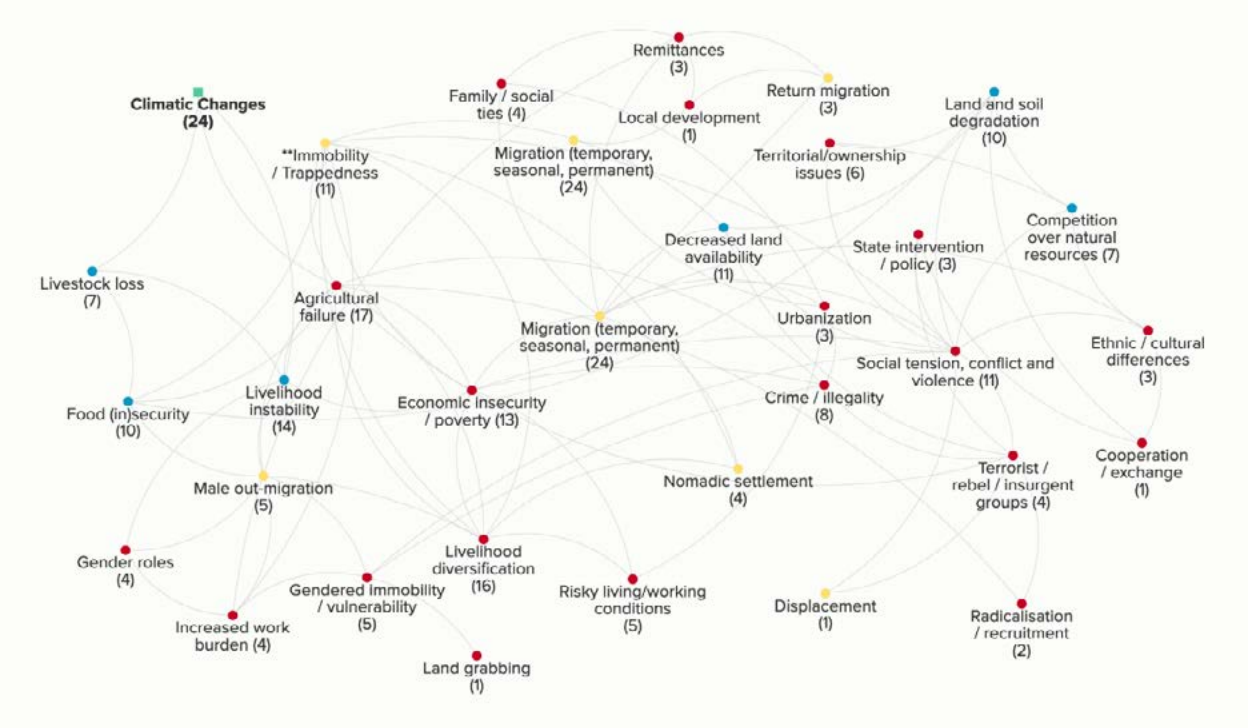

Figure 27. Migration and immobility impacts of natural resource degradation over the Sahel based on a literature review. Empirical connections from unstructured interviews and storytelling sessions organized by the authors. Green dots represent the environmental impacts, blue ones represent natural resource-based factors, red dots are human and social factors, yellow ones outline the (im)mobility outcomes and finally the purple dot indicates well-being. The numbers indicate how many out of the 24 selected journal articles made this specific link

In this way, the impacted land history contributed to decreased social cohesion and made people feel displaced as they never wanted or tried to set up a new life in their migration destinations.

5.6 Resource degradation and (im) mobility in the context of climatic changes in the Sahel

The literature captures many aspects of natural resource degradation and (im)mobility in the Sahel region. These aspects form complex relationships, with three key pathways identified from the results. There is much overlap between these pathways (as visible in the systems map), which together shape migration patterns in the region (see Figure 27). The susceptibility of various populations to become mobile or immobile is differently impacted by natural resource stresses. These disparate mobility impacts affect groups differently according to factors such as age, gender, livelihood and region.

However, although the literature highlights strong connections between natural resource stress and human (im)mobility in the Sahel, there is unlikely to be one single cause responsible. Migration decisions may also be influenced by access to natural resources in specific socioeconomic, political or demographic contexts that also shape patterns of (im)mobility. Viewing migration solely through the lens of climatic changes runs the risk of ignoring crucial factors and reducing the issue to an oversimplified cause-effect phenomenon. Notably, Drees and Liehr (2015) observe that socioeconomic and political conditions have a greater impact on mobility patterns than changing environmental conditions in the Sahel region.

Viewing migration solely through the lens of climatic changes runs the risk of ignoring crucial factors and reducing the issue to an oversimplified cause-effect phenomeno

5.6.1 Pathway: Natural resource strains, gendered (im)mobility and food insecurity

Much of the literature supports the assertion that livelihoods in the Sahel are highly dependent on rain-fed agriculture and vulnerable to the effects of drought, with the latter decreasing agricultural productivity and exacerbating food insecurity (Afifi 2011b; Ayeb-Karlsson et al. 2019; Ele 2020; Freeman 2017; Gueye et al. 2015; Ibnouf 2011; Nawrotzki, Schlak et al. 2016; Onwutuebe 2019; Sanfo et al. 2017; Scheffran et al. 2012; Traore and Owiyo 2013). A common coping strategy is for male members of the household to move away and find seasonal or permanent work in far-off destinations to diversify the family livelihood and support the household with remittances (Afifi 2011b; Djoudi and Brockhaus 2011; Henry, Schoumaker et al. 2004; Ibnouf 2011; Onwutuebe 2019; Traore and Owiyo 2013).

This can lead to an increase in the percentage of female-headed households. The departure of males often leaves women with more of a role in producing and providing food for the household, taking on new tasks such as livestock herding and charcoal production (Djoudi and Brockhaus 2011). Women also attempt to restore deteriorating environmental conditions through activities such as tree planting and digging reservoirs for water. This shifting of food and water security-related work tasks to women increases their workload as they have to simultaneously carry out domestic and caring activities (according to traditional gender roles), as well as agricultural tasks (Afifi 2011b; Ibnouf 2011; Onwutuebe 2019).

This gendered double workload not only undermines women's ability to engage their own adaptive responses but also exacerbates food insecurity, as women-led farms reportedly achieve lower yields than male-led farms (Ibnouf 2011). As well as physical immobility, women's social mobility is restricted by gender norms. Women have limited access to natural resources, assets, decision-making and the market, which increases their financial insecurity (Djoudi and Brockhaus 2011; Onwutuebe 2019). This position of uncertainty can be exacerbated by unreliable remittances from male relatives (Afifi 2011b; Ayeb-Karlsson et al. 2019):

> ***Extract 59***
>
> /…/my life is different now; my husband travelled to town for work, irregular remittances from him aren't enough /…/ I am too overloaded, but what can I do, it is obligatory for my family (Ibnouf, 2011: 221).

However, although male outmigration and female immobility are sources of vulnerability for women, there might be long-term positives of these gendered patterns of migration. Male absence could be an opportunity for female empowerment by shifting gender relations and strengthening women's decision-making (Djoudi and Brockhaus 2011; Ibnouf 2011).

Another pattern seen in the Sahel is that natural resource degradation can restrict human mobility. Although drought, decreased rainfall and natural resource loss can act as push factors, they can also create trapped populations in areas of high climate and social vulnerability (Ayeb-Karlsson et al. 2019; Henry, Piche et al. 2004). Declining agricultural yields place economic strain on farmers, who then invest less in farmland management and become trapped in a vicious cycle of food and financial insecurity. The ensuing poverty prevents migration as an adaptive response, especially in food-insecure regions with high levels of undernutrition (Henry, Schoumaker et al. 2004; Nawrotzki, Schlak et al. 2016; Sanfo et al. 2017):

> ***Extract 60***
>
> The problems of food shortages mean that we have very little to invest when we need to think of how to deal with drier or wetter conditions. /…/ The special seeds are very expensive (Ayeb-Karlsson et al. 2019: 159).

Delta fishermen in Mali experience similar mobility challenges: lack of opportunity to change seasonal fishing migration routes or find new settlements creates trapped and immobile populations, which is exacerbated by high population densities and the elevated cost of finding new places to settle (Morand et al. 2012).

Lastly, herder reliance on "transhumance" appears to be decreasing (see Side box 6), with a shift from seasonal to permanent migration. While transhumance was traditionally a coping mechanism for natural resource strain, droughts and failed rains are leading to an increasing lack of good pastures for grazing (Ele 2020; Olaniyan and Okeke-Uzodike 2015; Traore and Owiyo 2013). This, alongside competition over land resources, leads to decreased herder mobility and increased vulnerability in extreme droughts (Afifi 2011b; Traore and Owiyo 2013). As a result, nomadic herders in Mali, Niger and Nigeria are increasingly seeking ways to lengthen stays or settle permanently in new areas and shift from purely cattle-based livelihoods to a combination of crop and livestock keeping (Brottem 2014; Owonikoko and Momodu 2020). Government policies such as anti-open grazing and attempts to annex land actively encourage herders to establish ranches and become immobile, which can produce controversy and conflict related to land ownership (Ele 2020).

Side box 6: Applying the Displacement Tracking Matrix to the resource nexus in transhumance farming

IOM - Displacement Tracking Matrix

Transhumance is a farming method in which herders accompany herds in search of pasture and water points. It can operate internally in a country or cover several countries, and often extends over large distances. Cross-border transhumance is a major phenomenon in West Africa, and the Sahel region especially. Transhumance has been an important economic activity and a driver of regional development. In recent decades, it has been subject to significant upheavals. Climatic variability, demographic pressure, growing competition over scarce resources, political volatility and insecurity have deeply affected transhumance routes, patterns and flows. Under these transhumance movements, pre-established corridors and seasonal calendars are arranged among communities to create safe passage for animals and to offer them access to water. Due to environmental stress, transhumant herders tend to modify their routes, delay or bring forward departure or use alternative routes outside the established transhumance corridors. For these reasons, conflicts may arise between sedentary farmers and transhumant herders over the use of resources (and water access in particular).

To understand the impact of climate change on transhumance movements and the displacement due to associated conflict, IOM's Displacement Tracking Matrix (DTM) has developed the Transhumance Tracking Tool (TTT), which has been deployed across several countries in the West and Central Africa region. The aim is to provide the information needed to implement support programmes for populations involved in or affected by transhumance.

The TTT collects relevant information on key aspects such as transhumance corridors and livestock infrastructure; the transhumance calendar; the number and profiles of herders; conflicts between farmers and herders; and sudden movements of herds. Trained enumerators collect relevant data from key informants, community relays or transhumant herders themselves. The TTT is based on the following tools:

- Flow counting: The enumerators collect information on the origins and destinations of herds, herders' nationalities and periods of arrivals and the numbers and kind of livestock. These counting points are located mainly around animal gathering points and on border crossings.
- Alert: It could be either a "Prevention" alert, triggered by unexpected movements (early, late, massive) that may have an impact on an area, or an "Event" alert, triggered in the event of an agro-pastoral conflict to provide information on the incident and guide the appropriate response.
- Surveys: This tool, based on the needs of the mission, is used to obtain qualitative information on a topic or specific theme. Through dedicated questionnaires, the surveys will be administered to a random sample of people in order to gather detailed information and explore a specific topic.

The main findings of the initial data collection exercises in countries of the West and Central Africa region where the TTT has been deployed are reported below:

- Central African Republic: farmland and water points have been identified as one of the main places where tensions and conflicts between farmers and herders may arise. In particular, conflicts were recorded in 54% of the localities, with farmland and water points mentioned as the most common points of conflict (97% and 73% of the relevant localities, respectively). Specifically linked to water sources, focus groups reported that 43% of the water points used by transhumant herders are in localities of passage, thereby highlighting the additional pressure on water sources used by non-transhumant communities and reinforcing the idea of water points as potential sources of conflicts.
- Mauritania: key informants reported that 77% of transhumant herders faced some challenges in their routes. Specifically, 62% of the herders faced environmental challenges, including droughts that affected their search for grazing land and water sources, and 6% were involved in conflicts with local communities due to environmental stress.
- Burkina Faso: among the conflicts identified through the "event" alert in the period December 2019 - February 2020, 32% were conflicts between transhumant herders and farmers. The main causes of the tensions were damage to crops caused by herds (60% of cases) and use of alternative routes outside the official transhumance corridors (16%).
- Cameroon: in the period November-December 2020, 345 agro-pastoral conflicts linked to transhumant movements were reported in the region bordering Chad and the Central African Republic. At the end of that year, 45% of the conflicts identified were unresolved and half of them involved a potential risk of retaliation as reported by key informants.

5.6.2 Pathway: Land degradation, resource competition and herder-farmer conflict

One significant migration pattern and source of conflict in the Sahel is the long-distance migration of cattle herders in response to natural resource strains, especially in Nigeria, Niger and Mali. Recurrent drought, desertification, erratic rainfall, decreased grazing resources and cattle death (especially in dry seasons) force herders to migrate to wetter regions in search of new grazing spaces (Afifi 2011b; Akinyemi and Olaniyan 2017; Ele 2020; Howorth and O'Keefe 1999; Olaniyan and Okeke-Uzodike 2015; Owonikoko and Momodu 2020):

Extract 61

> We herders are often chased about by drought. It is often said that pastoral farmers have no home. We do have homes, but our profession forces us to move when we are confronted with drought (Akinyemi & Olaniyan, 2017: 11).

Sometimes this can lead to cooperation and negotiation between indigenous and immigrant groups, with inter-ethnic exchanges of skills, farming practices, gifts and cultural practices. By cooperating in this way, societies can develop new natural resource-use patterns with shared objectives to guarantee subsistence (Howorth and O'Keefe 1999). However, herder migration can often trigger conflict between herders and farmers in host areas for a number of natural resource-related reasons: destruction of farmland by cattle, locals killing cattle, competition for water and land, pollution of water by cattle and crop theft (Afifi 2011b; Akinyemi and Olaniyan 2017; Brottem 2014; Olaniyan and Okeke-Uzodike 2015):

Extract 62

> The crux of the matter is that the cattle would enter and destroy crops in the farms. The farmers retaliate by attacking or killing the animals. This would lead to clashes and, in most cases, results in loss of human lives and properties. It is a frequent problem. It happens regularly (Olaniyan & Okeke-Uzodike 2015).

Alongside natural resource-related issues, culture and identity differences can bring farmer and herder groups into conflict. One example is farmers' perceptions that herders are insensitive to host customs and values (Madu and Nwankwo 2020; Olaniyan and Okeke-Uzodike 2015). Crimes such as harassment, rape and theft also occur between opposing groups, plunging them into subsequent violence. These conflicts, fed by underlying deprivation and frustration, lead to death, lost homes, destroyed property and damaged land, thereby further exacerbating poverty and food insecurity (Akinyemi and Olaniyan 2017; Ele 2020; Madu and Nwankwo 2020; Owonikoko and Momodu 2020).

These issues of land rights and ownership in a context of scarce natural resources are major problems that government policy has attempted to address by establishing livestock passage corridors and grazing zones for herders. However, this conflict management strategy also produces territorial issues, as it is seen by farmers as a way of strengthening the land rights of herders (Brottem 2014; Ele 2020). Alternative policy mechanisms involve attempts to settle herders, which in turn can become a source of controversy and conflict (Ele 2020). The failure of such conflict management and mediation systems can reduce the confidence of social groups, who tend to resort to self-defence rather than engaging in mediation processes (Akinyemi and Olaniyan 2017). The 1998 Protocol on Transhumance from the Economic Community of West African States (ECOWAS) is a multilateral agreement that recognizes the value of cross-border mobility while also aiming to prevent and resolve potential conflicts. However, there is a need for regional strategies in order to promote peace. Supporting local conflict resolution committees and consulting pastoralists and farmers when developing conflict prevention measures are examples of such strategies (United Nations Office for West Africa and the Sahel [UNOWAS] 2018). or West Africa and the Sahel (UNOWAS) 2018).

5.6.3 Pathway: Natural resource loss, illegal activities and social protection

The traumatic effects of drought on rural landscapes lead to crop loss, field loss (due to soil and wind erosion), reduced crop fertility and livestock failures (Afifi 2011; Ele 2020; Gueye et al. 2015; Kamta et al. 2020; Olaniyan and Okeke-Uzodike 2015; Onwutuebe 2019; Sanfo et al. 2017; Seiyefa 2019; Traore and Owiyo 2013). The downstream impacts of these agricultural failures can result in crime and illegal activities. For instance, one adaptive solution to poverty and climate insecurity is to migrate from rural areas to cities, leading to rapid urbanization. The density of urban populations combined with a lack of planning leads to informal and illegal settlements with unsafe living conditions, such as slum areas that are prone to flash flooding (Ayeb-Karlsson et al. 2019; Gueye et al. 2015). Many migrants are unable to

find work and remain unemployed, which fuels urban social crises involving crime and violence (Owonikoko and Momodu 2020). Another social protection issue involves child mobility: one study reports that drought-shocked households in Senegal are more likely to have a child living away from home as a mitigation effort to create and consolidate social networks and diversify skill sets. Young boys frequently live away for Quranic studies as talibés, but can engage in risky activities such as begging in the streets (Kielland and Kebede 2020).

Another mechanism to adapt to livelihood loss is to violently compete for natural resources or seek alternative illegal means to survive. Marginalized and resource-poor groups can resort to criminal activities such as smuggling illegal goods or services, drug trafficking, child trafficking and recruitment for warlords (Owonikoko and Momodu 2020; Seiyefa 2019). Furthermore, the economic and social fragility caused by natural resource degradation can be exploited by criminal and terrorist networks for opportunistic recruitment. In the Lake Chad basin, Boko Haram and Al-Qaida are reported to have exploited the lake shrinkage and ensuing poverty to radicalize and recruit new members (Owonikoko and Momodu 2020; Seiyefa 2019):

Extract 63

> A few days ago (referring to June 2015), Boko Haram militiamen came to our village, which is ten kilometres from Bourrah, and they told us to stop wasting our lives here and join them in the holy battle to save our faith and the lives of our families. They also said that Boko Haram is young people's only future . . . [They] also told us that we would get paid from 600 USD to 800 USD a month if we joined them. It is a lot of money to us, if you consider that we cannot even make 70 USD a month from our work . . . I was scared and I declined their offer, but many of my friends accepted (Owonikoko and Momodu 2020:1310).

Extract 64

> Some are dislodged by environmental issues in the Lake Chad Area. [...] Going back to their areas is difficult because what drove them out is still there. Involvement in criminality in cities is usually a coping mechanism for the excruciating challenges they face with regard to sustaining their living in cities (Owonikoko and Momodu 2020:1311).

The insurgencies themselves are a primary cause of forced displacement and threaten the agricultural sector as farmers fear attack (Kamta et al. 2020). Extremism and violence are also used by Fulani herders to advance their own agenda, with the herder-farmer conflicts fuelling rises in unregistered deadly weapons and armed civilians (Ele 2020). The groups can appeal to the grievances of people who are already vulnerable having suffered farming losses and offer economic incentives to join violent networks (Owonikoko and Momodu 2020). In this way, societies that are more dependent on natural resources may be more vulnerable to conflict.

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6

ADDRESSING THE RESOURCE-HUMAN MOBILITY NEXUS: POLICY OPTIONS

6.1 Introduction

The complex linkages between mobility and natural resources underlined by this report highlight a number of policy areas. Considering that resources and mobility have typically been seen as separate rather than interrelated, it is unsurprising that there are relatively few policies that cover both. Tentative forecasts and possible causal linkages between resources and mobility do, however, point to a few policy areas that merit broader discussion. Rather than categorizing the content by sector, level, thematic field or organizational type, this chapter asks two basic questions about the concerns to be targeted in the resource-mobility nexus and the relevant policies that need to be identified to resolve the issues. The chapter also considers existing or potential policies in areas of innovation or theories of change that may be worth examining despite the current lack of clear evaluative data. All policies are critically assessed using a literature review plus online consultation with academic experts and policymakers. Details of these experts are included in the Appendices.

Linear explanations for mobility should clearly be avoided. As stated in the preceding analysis, however, it is not unreasonable to say that diminishing finite resources and the degradation of renewable resources, in combination with other socioeconomic and political aspects, are likely to exert a growing influence on mobility trends and patterns. Effective policymaking therefore needs to pragmatically intersect with current and predicted trends. There are two relevant policymaking factors. The first element is to increase the possibility of adaptation, greater sustainability of resources and socioeconomic and environmental resilience in vulnerable or marginal contexts. This is so that resource pressures do not force people to move in the first instance. Secondly, failing that, the question is how the safe, equitable and well-organized movement of people away from such areas can be managed to provide livelihood opportunities for those displaced, minimize the resource impacts and fosters adaptive capacity in destination locations. This chapter is shaped around these two clusters of policymaking best practice for staying and moving in the context of resources and migration.

6.2 Which elements of the resource-mobility nexus do policies seek to address?

1. Options for staying: policies to increase resilience at places of origin. The question is whether adaptation or resilience can be increased and vulnerability reduced among populations that are susceptible to potential resource pressures so that people do not feel the need to move. The next questions is whether it makes sense to focus on improving sustainability of resource stocks and preventing further detrimental changes. The alternative would be to focus on socioeconomic aspects that might improve coping mechanisms if shifts in resources seem inevitable. In addition, as highlighted in Chapter 5, policymaking should pay particular attention to trapped populations: groups or individuals that do not have the option of adapting or moving due to social, economic, political or environmental barriers. In this context, it is vital to understand that resource pressures might be particularly severe and/or social and economic conditions are likely to be extremely precarious.

2. Options for moving: policies that facilitate adaptation and sustainable resource use at destination. Although no migration is entirely driven by environmental influences alone, the extraction, exploitation and diminishment of resources can, in some contexts, be a primary motivation for movement. When this is the case now or in the future, policymaking should focus on facilitating (temporary or permanent) mobility flows and livelihood opportunities for those relocating. Subsequent policy attention should target the sustainable management of resources in areas that receive inwards migration in the form of people moving towards resources or being displaced by harnessing of resources. The aim is to ensure that areas of inwards migration do not also experience mounting resource pressures themselves.

Policies for staying or moving provide the structure of the forthcoming sections that identify policy areas relevant to resources and mobility. As with the report's other chapters, the focus here is on specific policy connections with the themes of resources and mobility. While the chapter does offer examples of policies in action, it simply highlights general policy areas and points of discussion, rather than providing a systematic assessment of regional and national policies or wider socioeconomic, environmental and sustainability frameworks. This is in keeping with the aim of viewing mobility through the lens of resources.

6.3 A review of policies for "staying and going"

6.3.1 Options for staying: policies to increase resilience at places of origin

At places of origin associated with mobility or socioeconomic and environmental vulnerability, the use and control of resources may interact with social, economic and political forces to encourage migration for those able to move. However, there are also vulnerable populations who may urgently need to move (following a disaster) or gradually wish to move (due to slow-onset changes) but are unable to do so for various reasons. These groups are sometimes described as "trapped", because of their inability to escape undesirable or hazardous circumstances (Black et al. 2013; Foresight 2011). In both cases, using conservation and reclamation techniques to strengthen the vitality and sustainability of the resource base has the potential to improve socioeconomic resilience, especially where livelihoods are strongly tied to natural resources (such as agriculture and fisheries). Ensuring local communities have rights of ownership and tenure over these resources has the potential to create a greater vested interest in protecting the resource base. In addition, fostering livelihoods that are less reliant upon resources can also alleviate pressure on resource stocks. External inputs to and assistance in the socioenvironmental system (such as remittances and targeted development assistance) may also help alleviate resource pressures. In the case of natural disasters, more rapid assistance may be needed to help populations move on a temporary or permanent basis.

6.3.1.1 Soil and water resource conservation and reclamation policies

Protection of soil and water resources and reclamation of degraded resources are connected to reducing forced displacement and immobility. Maintaining the stability of soils and biomass, particularly in coastal and mountainous regions, protects against extreme weather and related natural disasters such as flooding and landslides that increase migration or vulnerability in the most severe situations. In a less extreme way over longer periods, the sustainability of soil and water resources ensures the ongoing viability of numerous vital ecosystem services. This includes biodiversity, which is increasingly understood as worthy of protection on an intrinsic and instrumental level, and protecting land mass from erosion. Soil and water are also intrinsically connected: soils require appropriate levels of moisture to maintain their fertility and stability; unstable soils are most at risk of water erosion; and lack of water and unsustainable land practices can result in degradation, erosion and desertification (Gruver 2013).

Substantial responses to pervasive degradation of soil and water resources include Africa's Great Green Wall, which is the inaugural project of the UN's Decade on Ecosystem Restoration that aims to restore some 8,000 km of degraded land across the continent's Sahelian regions, and the ambition to raise US$50 billion to restore drought-stricken areas around Lake Chad. In terms of soil and water resources, it is essential to consider agricultural practices, as these are carried out half of Earth's useable land, while also accounting for 70% of global freshwater withdrawals and many livelihoods – particularly in poorer and environmentally vulnerable settings (FAO 2017). Depletion of these resource stocks can increase poverty and vulnerability (Barrett and Bevis 2015) and encourage movement if populations and livelihoods cannot solve the problems or adapt to gradual changes.

The impetus behind conservation and reclamation of soil and water resources is by no means new or limited to extreme settings (such as the Dust Bowl in the agricultural heartlands of the United States in Side box 10). However, despite considerable research into the environmental and socioeconomic importance of conserving quality and quantity of soil and water resources (Scherr and Yadav 1996), prevailing practices in commercial and subsistence agriculture have tended to overlook such conservation efforts (Albaladejo et al. 2021; Borrelli et al. 2017, 2020).

In their review of global achievements in soil and water conservation practices, Kassam et al. (2014) summarize the three key interlinked principles of conservation agriculture as: (i) minimizing or avoiding mechanical soil disturbance; (ii) maintaining continuous soil cover of organic top layers with plants; and (iii) adopting practices that include a diversity of (context-selected) plant species and farming systems that help enhance soil quality and the system resilience that is invariably connected to soil health. Some of the benefits listed by the authors include:

- Increased factor productivities and yields (depending on prevailing yield levels and extent of soil degradation); up to 70% decrease in fuel energy or manual labour; up to 50% less fertilizer use; 20%

or more reduction in pesticide and herbicide use; around 30% lower water requirement; and reduced cost outlay on farm machinery.

- Enhanced climate change adaptability of cropping systems, farms and landscapes because of improved soil-plant moisture relations, while also achieving greater carbon sequestration and lower emissions of greenhouse gases.
- Decreased flood risks due to higher rainfall infiltration and reduced run-off and soil erosion. This raises water resource quality and quantity, and can reduce infrastructure maintenance costs and water-treatment costs.

Worldwide experience has established that similar or higher yields can be obtained with no-tillage compared with conventional tillage systems. The assessment by Abdul-Rahim et al. (2018) of farm outputs and poverty rates in parts of China with high implementation rates of soil and water conservation led them to suggest that such practices "can contribute to the agricultural economic growth and rural poverty reduction" and that, along with capital inputs, they "are now more important in poverty reduction and economic growth than farmland area and agricultural labour".

On an international policymaking level, this document advocates conservation and sustainable agriculture approaches adopted by the Organisation for Economic Co-operation and Development (OECD) (2010), United Nations Convention to Combat Desertification (UNCCD) (2014) and FAO (2017) (also see Side box 8). These include a systems approach that aims to enhance productivity, maintain ecosystem services and strengthen farmers' resilience to environmental changes. Despite the fact that these practices are likely to contribute to the sustainability of soil and water resources, as shown in Table 5 their official adoption such in agriculture in areas like Asia and Africa is particularly low.

Continent	Area (ha)	Percentage of total	CA as percentage of arable cropland
South America	55,464,100	45	57.3
North America	39,981,000	32	15.4
Australia & NZ	17,162,000	14	69.0
Russia & Ukraine	5,100,000	4	3.3
Asia	4,723,000	4	0.9
Europe	1,351,900	1	0.5
Africa	1,012,840	1	0.3
World	124,794,840	100	8.8

Table 5. Global area distribution of conservation agriculture by continent (Source: Kassam et al. 2014)

Albaladejo et al. (2021), FAO (2017), Kassam et al. (2014) and Keesstra et al. (2016) provide excellent analyses of the potential and pitfalls of pragmatic policymaking approaches towards soil and water resources in agriculture. Most of these align with the content of this report so far (see below): a lack of baseline and available information on resource stocks and quality; consequent challenges with modelling, monitoring and management; inappropriate and/or ineffective international to local scale legislative approaches towards soil and water resources; and actual or perceived livelihood insecurity resulting from lack of local ownership over such resources and assistance in their management.

Side box 8: Migration and agroecology in West Africa

West Africa is particularly vulnerable to pressures on natural resources. The Sahelian environment that makes up much of the region is susceptible to degradation and desertification as a result of climatic change and/or unsustainable land use. At the same time, as in most of Africa, a high proportion of the population remain dependent on land viability for subsistence and smallholder agricultural practices. Detrimental impacts on agricultural and food production systems have been found to have strong links to movement of people within and across borders within West Africa.

Agroecology is a promising approach that combines the related aims of increasing food security, social resilience and land use sustainability in this context. According to FAO, agroecology is "based on applying ecological concepts and principles to optimize interactions between plants, animals, humans and the environment while taking into consideration the social aspects that need to be addressed for a sustainable and fair food system". As well as being tailored to local contexts, agroecology is also aligned with the objectives of wider international policies under the Paris Agreement, UNCCD, the CBD and several SDGs. The first United Nations Food Systems Summit in 2021 also promoted an agroecological approach.

In relation to migration, an effective transition to agroecology is thought to have the potential to benefit marginalized communities by increasing sustainable livelihoods and giving some freedom of choice in mobility decision-making there. A well-functioning and successful agricultural sector is also considered able to absorb/attract West Africa's many unemployed young people (who might otherwise migrate) and make productive use of the large remittances received from family members in urban areas and in the diaspora.

The Economic Community of West African States (ECOWAS) proposed a support programme for an agroecological transition in 2005 as the organization adopted the Economic Community of West Africa Agricultural Policy (ECOWAP). However, the policy has yet to be properly implemented due to a lack of coordination and clear strategy, according to Oxfam (2015). As well as such policymaking hurdles, other structural barriers to growing agroecology in the region include insecure land tenure, lack of assistance and training and loss of agricultural land (particularly in peri-urban areas).

Side box 9: Historical context of resource-migration nexus policies – the Dust Bowl[47]

One well-documented example of a policy nexus to resource degradation and migration is the legislative response to the Dust Bowl period of the 1930s in the United States and its continuing legacy in the country's natural resource management. The unsustainable short-term policies that led to this ecological disaster, as well as the policymaking response, provide some insights on what to avoid in the face of economic pressures and the logistical and time commitments needed to resolve them.

The Dust Bowl led to the single largest internal displacement in American history with over 3 million people relocating from the centre of the country to the coasts. Specific policies to encourage farming and tillage led to massive soil erosion, threatened food security for the country and left more than half a million people homeless. Unsustainable tillage practices, which are estimated to have eroded more than 70% of the topsoil in Northern Texas, Oklahoma, Colorado and Kansas, were accentuated by droughts. The United States Homestead Act of 1862 required settlers to cultivate their fields for five consecutive years in order to protect their property right, although the 1909 Act reduced that to three years. The result was a massive plough-up for farming that broke up the native sod of short grasses that were protecting underlying soils from erosion. Estimates from historical records of land degradation indicate that 104 million acres of native sod were ploughed under by homesteaders throughout the region between initial settlement in 1880 and 1900, 20 million by 1925 and 5 million more by 1930 (Egan 2006).

Motivated by President Franklin Delano Roosevelt's New Deal and recognizing the extent of land degradation in the American Midwest, on 27 April 1935 Congress passed Public Law 74-46. This specifically noted that "the wastage of soil and moisture resources on farm, grazing, and forest lands...is a menace to the national welfare" and established the Soil Conservation Service (SCS) as a permanent agency in the United States Department of Agriculture (USDA).

The SCS tackled the related issues of wide-scale erosion of soil resources and shortage of water availability in a number of ways. Its success was based upon a breadth and depth of resources. A

47 This section summarizes descriptions of the Dust Bowl from established United States Department of Agriculture histories at Honoring 86 Years of NRCS – A Brief History | NRCS (usda.gov).

year after its creation, the Service had around 150 projects demonstrating soil conservation techniques, nearly 50 plant nurseries, 23 soil science research stations, over 450 Civilian Conservation Corps camps and a workforce of over 23,000 Works Progress Administration staff. The push for state legislators to encourage and facilitate local landowners to form soil conservation districts that began in 1937 has been responsible for the establishment of just under 3,000 such areas today. The post-war period saw further expansion of soil conservation efforts and, importantly, a greater focus on water resources with the adoption of the Watershed Protection and Flood Prevention Act (P.L. 84-566). The Service became instrumental in the construction of 11,000 dams on some 2,000 watershed projects that provided important flood control benefits, although there was some controversy over the displacements resulting from reservoir construction. Policies to better manage such resettlements will be discussed later in this chapter.

Efforts to ensure the sustainability of resources within Middle America's economy continued into the 1970s, this time complemented by a growing public awareness of environmental damage and the need for conservation. Congress authorized the National Resources Inventory (NRI) in the Rural Development Act of 1972 (P.L. 92-419) to monitor and assess the nation's natural resource base and consider the implications of land use changes for soil erosion. A major productivity and debt crisis in the 1980s, which impacted farms with land values declining as much as 60%, provided an opportunity to test innovative conservation policies. The Soil and Water Resource Conservation Act (RCA) of 1977 established the Conservation Reserve Program (CRP) to provide rental payments to farmers for giving cropland over to grass or trees, a precursor to similar strategies adopted in Europe around a decade later. Conservation tillage practices became widely adopted during this period with a range technology transfer and training programmes implemented by USDA. In addition, the Food Security Act of 1985 (P.L. 99-198) had provisions known as "Sodbuster," "Swampbuster" and separate provisions for Highly Erodible Lands (HEL) that made specific conservation management techniques a prerequisite for participation in USDA programmes.

A detailed evaluation of this key period of policy experimentation was produced by the United States National Research Council (1993). Some of the key policy points subsequently used to keep rural farming communities productive and mitigate urban migration included:

1. Price support, deficiency payment and supply control policies reformed to remove the barriers to voluntary adoption of improved farming systems.

2. Current price support and supply control programmes redesigned to increase the flexibility participants have to plant different crops to boost the use of crop rotations, cover crops and other changes in cropping systems.

3. Long-term protection of soil and water quality should be based on policies and programmes that are independent of price support, supply control or income support mechanisms; policies are needed that target problem areas and problem farms regardless of participation in federal commodity support programmes.

4. A programme to purchase selective use rights from producers through long-term easements should be developed to provide incentives to producers to use environmentally sensitive lands sustainably so that they do not threaten soil and water quality.

5. An easement programme should be designed to support rather than replace efforts to accelerate voluntary change or to initiate regulations. Furthermore, programmes should be designed so that state and local governments can supplement it with efforts of their own.

Soon after the publication of these policy recommendations, the SCS became the Natural Resources Conservation Service (NRCS), with the new name suggesting a more expansive mandate linking with broader goals of ecological restoration. Since then, the NRCS has participated in a variety of restoration projects – some of which may be in response to ecological engineering challenges involving the Army Corps of Engineers or other government agencies. The NRCS also took over management of the Wetland Reserve Program, which includes a restoration mandate as well as maintenance of long-term or permanent easements.

This recent historic case provides a contemporary ex-post view of extensive resource degradation and legislative responses. Its institutional and research experiences have been crosscutting: the American experience of the Dust Bowl migration and subsequent policy reforms continue to be emulated in many other countries through the USDA's Foreign Agricultural Service program, often in partnership with the United States Agency for International Development. They also speak to the necessary longevity of policymaking responses to resource disturbances that can take many years to recover while affecting multiple generations of a population.

6.3.1.2 Land tenure policies and human mobility

Historical lessons like those of the Dust Bowl suggest that some of the strongest connections between natural resources and human mobility relate to land degradation and restoration practices. If people are going to remain in a region, land ownership creates a vested interest for attachment and – even where there is seasonal or cyclical mobility – a reason to return. Policies on land tenure can be instrumental in shaping how populations interact with the natural resource base and therefore also in managing human mobility. However, these relationships are complex and often appear counterintuitive: lack of access to land tenure can spur migration, as well as lead to trapped populations – depending on the context of opportunities at destination.

For example, in a study of urban migration trends in China, which has the highest levels of human mobility in the twentieth century, Mullan et al. (2011) found rural property rights to play an important role in migration decisions. By examining the relationship between insecurity of tenure, restrictions on land rentals and participation in outside labour markets, the authors found that tenure insecurity reduces rural-urban migration. This relationship is particularly significant on forest land, which has implications for the conservation of recently replanted forest areas. However, increasing formalization of land-tenure systems can also promote migration. In a separate study, Ma et al. (2014) found that perceived tenure security plays a significant role only in those villages without operational land-rental markets. They state that "in villages with underdeveloped land rental markets, households that expect that no land reallocations will occur within their village in the near future are less involved in migration, while households that attach a greater importance to land certificates in protecting land use rights are more involved in migration". In terms of policies intended to promote ownership of resources, the localized and sociological dynamics and migration implications need to be thoroughly assessed before and after implementation.


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Side box 10: Case analysis of land tenure policy implementation in Kenya

A case study of Kenya is presented to illustrate some key aspects of legislation and policies to address the land tenure nexus with migration. The example is relevant as it involves a developing country with high levels of internal displacement, a large refugee population (from neighbouring Somalia) and international migration. Although there were several reasons behind the policy reform, the country was also used as an example by the International Organization for Migration (IOM) and various partner organizations in their flagship collaborative project on Migration, Environment and Climates Change: Evidence for Policy (MECLEP).

Kenya's land laws exemplify policies that have led to displacement and landlessness, as well as settlement in environmentally vulnerable areas. In 1999, the Government made a concerted effort to address these policy failures through the establishment of a Committee on Land Clashes and the Njonjo Commission of Inquiry into the Land Law System of Kenya. Four years later there was an additional Commission of Inquiry into the Illegal/Irregular Allocation of Public Land. A national land policy formulation process started in 2004 and led to a comprehensive set of policy guidance proposals set out in Paper No. 3 of 2009 on National Land Policy (NLP). The gravity of this work is reflected in the fact that the Constitution of 2010 included a chapter on Land and Environment (Chap. V), and Article 60 of this chapter sets out seven principles in this regard:

a. Equitable access to land;
b. Security of land rights;
c. Sustainable and productive management of land resources;
d. Transparent and cost-effective administration of land;
e. Sound conservation and protection of ecologically sensitive areas;
f. Elimination of gender discrimination in law, customs and practices related to land and property in land;
g. Encouragement of communities to settle land disputes through recognized local community initiatives consistent with the Constitution.

Kenya has considered the linkage between land tenure and migration in formulating policy, given the complex history of internal mobility of its many tribal groups. In 2012 the country's parliament passed the Act on the Prevention, Protection and Assistance to Internally Displaced Persons and Affected Communities. Policy analysis conducted by IOM suggests several shortcomings of this Act, and these can be summarized as follows (Schade 2016):

- The Act does not elaborate on compensation, nor does it refer to the Land Act sec. 155(4) for such matters.
- The Land Act does not detail guidelines for planned relocation or forced resettlement, but is more focused on formalizing and upgrading existing settlements and vacating public land required for public purposes.
- Although the Act sets some framework, it is clear that there are no detailed and comprehensive procedures for eviction and relocation in line with the Evictions and Resettlements Procedures (ERP) Bill.
- Although the Act has a stronger focus on emergencies and the Land Act's (re)settlement policy may have a stronger connotation on settling longstanding settlement issues, both have major overlaps in terms of: (a) (re)settlement as a durable solution; and (b) eviction and resettlement in the context of vacating land for public purposes such as development and conservation projects.

In 2016, Kenya promulgated the Community Land Act (CLA) that allows local communities to register and take the title of their communal lands. More than 3.5 million people would now be eligible to have title to their communal lands, covering roughly 150,000 square miles, or 67% of Kenya's landmass. Such policies have the potential to create more economic resilience for pastoral groups that are otherwise more vulnerable to resource-linked displacements. The CLA defines community as meaning "a consciously distinct or organized group of users who share any of the following attributes: common ancestry, similar culture or unique mode of livelihood, socio-economic or other similar common interest, geographical space, ecological space or ethnicity" (CLA s. 2). Community of interest is defined as "the possession or enjoyment of common rights, privileges or interests in land, living in the same geographical area or having such apparent association" (CLA s. 2). This is a comprehensive definition that recognizes ecological factors and human mobility within communal lands. Overall, the law has the potential to facilitate appropriate policies for implementation. Ultimately, however, the Government would have to

relinquish control over communal lands, and the law proposes a transitional period of trusteeship. This is where ambiguities could delay effective policy implementation. In a review of the law and possible policies, Wily (2018) notes that those lands with extensive natural resources such as timber will be particularly challenging in this regard:

> *"Forests on community lands promise to be first in the firing line, given the well-known reluctance of forest authorities to use its constitutional right to transfer lands from public to private and community categories of ownership, and despite a global conservation environment in which community owner-conservator norms are recognized as a viable, cheap and sustainable route to forest rehabilitation and conservation for the long term."*

Nevertheless, the Kenyan case of policy reform towards land tenure has potential for decoupling the resource nexus with human mobility and making decisions on movement that are unrelated to particular natural resource constraints. Other governments, particularly in developing countries with indigenous communal lands, can learn from this experience and create greater resilience within their populations.

Recent reviews of the significant associated literature (such as Higgins et al. 2018; Simbizi et al. 2014; Tseng et al. 2020) indicate that, although net positive outcomes are dependent upon the local context and the effectiveness of policymaking, improving local people's control over land resources has a predominantly positive effects on socioeconomic and environmental parameters. This is particularly the case for regions such as sub-Saharan Africa, where persistent, outdated tenure arrangements (including green grabbing discussed below) and land degradation have been cause for concern, as well as East Asia, which has experienced rapid industrialization and changes in population dynamics. With the caveat that policymakers need to implement land tenure security arrangements thoughtfully, enabling local communities to have control over and vested interests in land-based livelihood resources appears key to preventing outwards migration linked to resource degradation or limited supply per capita.

6.3.1.3 Policies to mitigate "green grabbing"

There have been ongoing concerns that, without financial support and localized resource security, many communities in source countries can be the target of land grabs by large multinational agricultural interests. Some of these acquisitions may be ostensibly for environmental projects such as biofuel production, solar farms or even carbon offsets. However, the growth of such "green grabbing" has led to a global civil society movement calling for the establishment of principles for donors and governments that will help with preventative policies. A coalition of 150 representatives of civil society, governments and international policymaking organizations from more than 45 countries met in Tirana, Albania, in 2011 to sign a Declaration on Securing land access for the poor in times of intensified natural resources competition. This declaration recognized the migration nexus:

> *"We note that land and other natural resources are increasingly scarce and under threat due to a number of factors, including population growth, migration, changes in consumption patterns, climate change, land degradation, corruption and other forms of poor governance. Moreover, this is taking place in a context in which the control of land is increasingly concentrated in the hands of a few, while at the same time, a growing number of rural and urban poor are left with small and fragmented lands. This fosters conflict and food insecurity, and exacerbates poverty."*

Policies that prevent such large-scale land acquisition require land-use planning regulations to be in sync with international investment laws that can often hold primacy at the level of federal law.

In relation to these concerns of green grabbing, the International Fund for Agricultural Development (IFAD) has also supported a US$20 million programme focused on improving existing farming practices in Rwanda. The programme prioritizes livestock production for food (milk and meat) and also manure to sustain organic farming in kitchen gardens and small plots. Similarly, IOM has supported agroecology policies that can raise the productivity of smallholder farmers and reduce their risk of being economically excluded by large land acquisitions that result in migration.

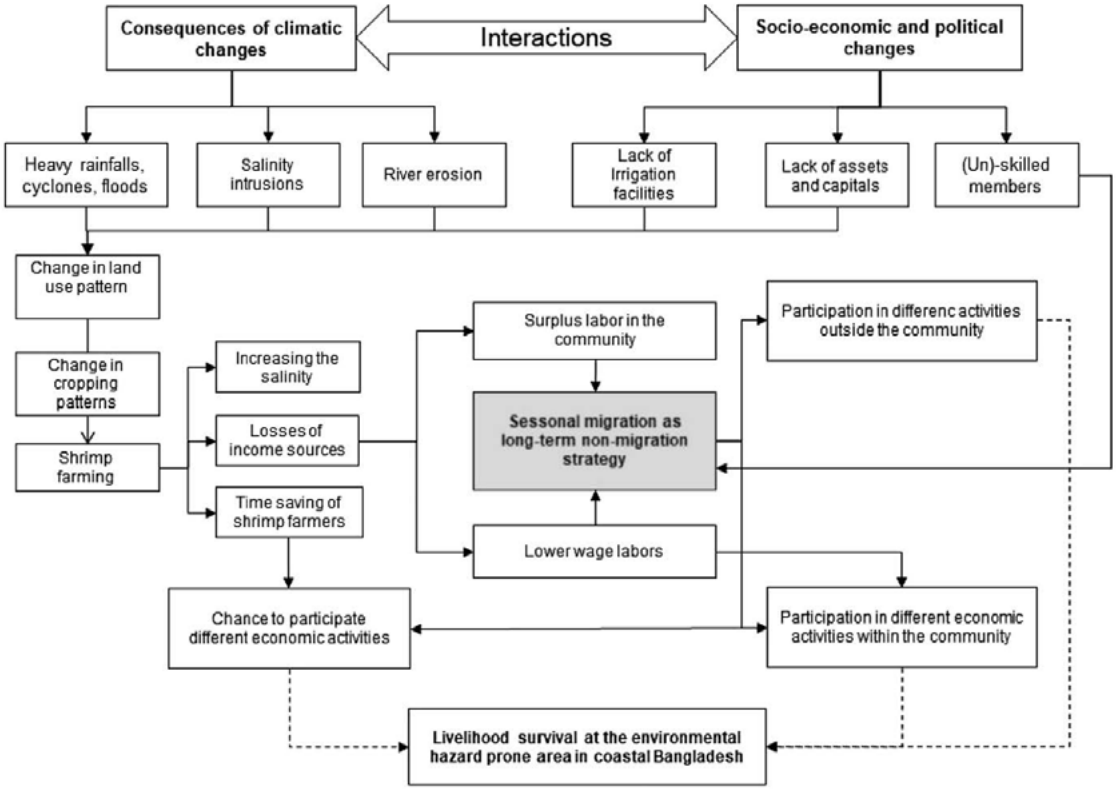

Figure 28. Potential policy intervention nodes in income diversification among coastal shrimp-farming communities in Bangladesh (Biswas and Mallick 2020).

6.3.1.4 Diversification of livelihoods with changing resources

Economic diversification is widely recognized as a way of ensuring resilience and creating multiple pathways for development when there are shocks to particular sectors. Policies that promote economic diversification can therefore reduce the need to migrate out of necessity. Diversification provides multiple career trajectories for young people and also facilitates hybrid incomes for families whose primary income sources may be seasonal or vulnerable to commodity price fluctuations (such as extractive industries) or security concerns (such as tourism). A study by Biswas and Mallick (2020) in Bangladesh revealed that diversification of income by shrimp farmers was an important mitigating factor in migration to urban areas of the country (Figure 28).

Economic diversification is widely recognized as a way of ensuring resilience and creating multiple pathways for development when there are shocks to particular sectors [...] Policies that promote economic diversification can therefore reduce the need to migrate out of necessity

One key aspect of diversification policies is multi-skilling of the labour force and flexible wage payment options. Women's education, plus the existence of several income earners in a household, can also help with income diversification. Tax policies that encourage multiple-income households can also be important ways of ensuring greater income resilience and diversification.

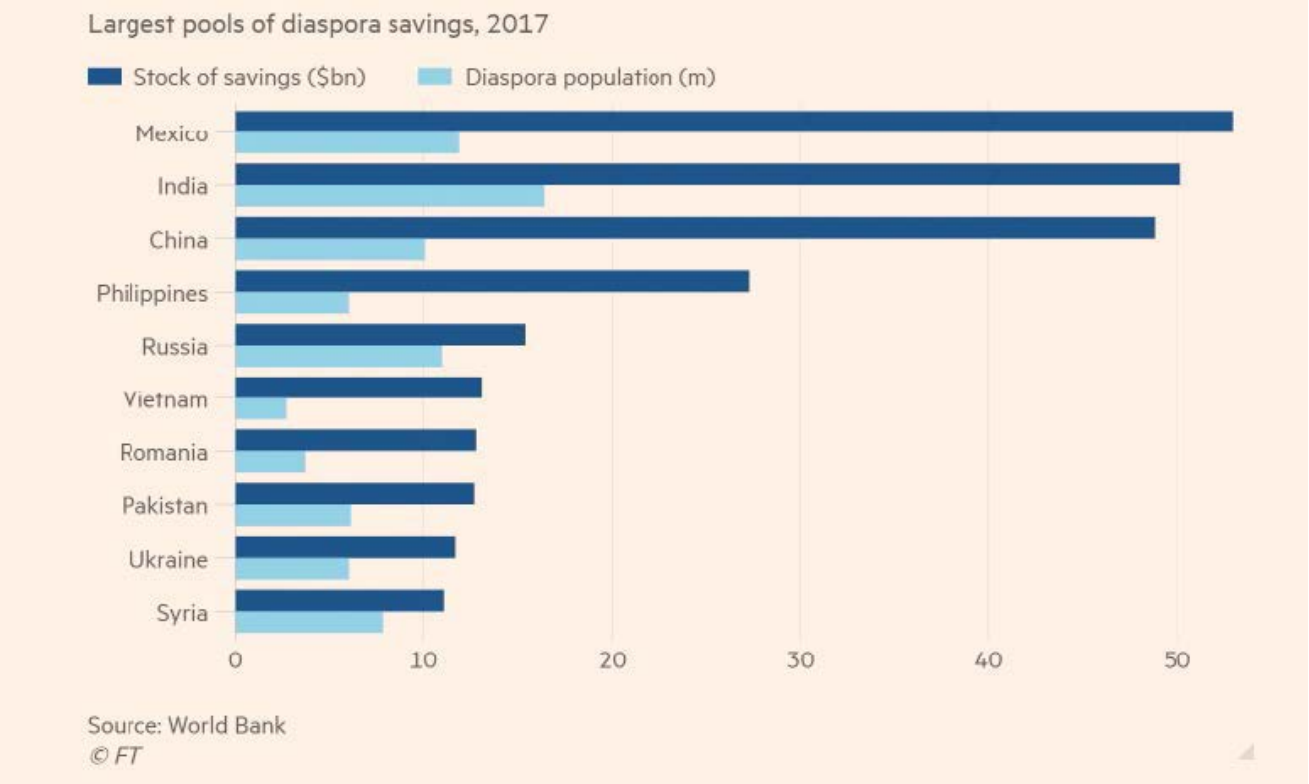

Figure 29. Diaspora savings and population estimates of top 10 countries (bar chart prepared by the Financial Times)

6.3.1.5 Remittance bonds

In cases of international population mobility from developing to developed countries or notable internal movement within countries (particularly from rural to urban areas), remittances can play an integral role in mitigating negative impacts on resource stocks in source countries. However, these policies will depend on the economic viability of migrants, and this variable can be highly sensitive to major economic shocks such as coronavirus disease (COVID-19). According to World Bank estimates, in 2020 remittance flows to low- and middle-income countries (LMICs) fell by 7.2% to US$508 billion, followed by a further decline of 7.5% to US$470 billion in 2021. Nevertheless, this is still a highly significant number and, for some recipient countries, remittances can be as high as a third of their GDP and often much higher than foreign direct investment (FDI) and development aid. In addition, despite a dearth of quantitative data, limited studies on internal remittances suggest that, while the values tend to be 30% lower than international remittances, they are five times as prevalent among households and much more likely to flow from urban to rural areas (Adams 2007; International Bank for Reconstruction and Development [IBRD] and World Bank 2006).

Policy formulation should consider the financial savings of the diaspora population and the demographics of migrants in specific locations. Figure 29 shows which countries have the potential to implement a range of remittance funds management policies. However, according to analysis of the global data on the contribution of remittances to the share of GDP, "the top 5 countries which received the highest remittances as a share of gross domestic product (GDP) in 2019 were: Tonga (37.6% of GDP), Haiti (37.1%), South Sudan (34.1%), the Kyrgyz Republic (29.2%), and Tajikistan (28.2%)" (World Bank Group 2020).

The most well-used and widely studied remittance finance policy in the context of migration relates to bonds that can help to create a funding mechanism for ecological restoration and other development activities linked to natural resources in source countries. These bonds are often termed diaspora bonds and operate like traditional bonds with the aim of providing predictable financing for governments in source countries. The bonds are bought by migrants with a return on investment that also helps their home country. In finance terms, these bonds are "untagged", which means that the issuer has flexibility about how to use the funds. In order for the bonds to work, however, there must be some trust in the home

country's financial and political system for migrants to take the risk of purchasing such securities. The Brookings Institution analysed these instruments in 2016 and noted the following key advantages of the remittance / diaspora bonds (Coleman 2016):

- Encourage external private investment in a developing country via an intermediary institution (for instance to structure the Social Impact Bond [SIB]/Development Impact Bond [DIB] and manage risk)
- Target remittance funds beyond family networks and in support of a social good that appeals to investors (such as health systems; education; early childhood development; or employment)
- Represent a structured financing vehicle that provides known rates of return and known levels of principal recovery/risk
- Target the diaspora, but could be presented as a retail investment option more generally (bond issues from the Development Corporation for Israel were targeted but not limited to the Jewish diaspora; India's bond issues were limited to investors of Indian origin)
- Access a multi-billion dollar global resource pool in which everyone (potentially) wins: returns for the investor if the intervention succeeds; achievement of a societal and developmental good (the activities supported by the SIB/DIB); and potentially reduced risk for outcome funders (through "payment for success").

The International Fund for Agricultural Development (IFAD) is a United Nations agency affiliated with the Food and Agricultural Organization (FAO). It has piloted 60 projects on development usage of funds from remittances through its Financing Facility for Remittances. IFAD's projects typically have two prongs. As with remittance bonds, these projects aim to capitalize on the potential investment capital of migrant workers. Under the aegis of the United Nations, this fund is trusted and its contents can be used for development activities. For example, the Financial Times covered a project in the Philippines where funds involved 1,260 recipient families and 1,500 migrant workers (mostly in Italy). When supplemented with grants from donors, the project channelled US$8m into projects such as agricultural cooperatives, creating 1,300 jobs. In Somalia, US$1m raised from the diaspora helped to finance the creation of 14 companies and 230 jobs in fishing, agriculture and food processing. The paper also noted that Nigeria's first diaspora bond was oversubscribed by 130% and raised $300 million, although Ethiopia had less convincing results with its 2008 and 2011 bonds (Financial Times 2019).

Such bonds work best if carefully structured and when they allow for early withdrawal if investors want to back other projects in the country concerned. Bonds were most successful during a crisis in the home country. The link between remittances, resources and migration was also considered in a think-piece previously published by the IRP. Figure 30 is a flow diagram from that publication that shows how remittances can play a positive and negative role in land degradation. The goal of policies should be to encourage the positive role through remittance bonds and to create incentives for more ecologically sustainable uses of private remittance funds received by families. The burden on migrants to boost their economies of origin can also seem daunting and raises questions of social justice and domestic responsibility of governments. The concept of social remittances, whereby key cultural norms (positive and negative for development) also deserves attention. Policies that promote key positive social remittance prospects, such as green entrepreneurship, should be encouraged. Existing domestic policies for more sustainable natural capital investments by citizens through tax and subsidy confluence can also be used in this way.

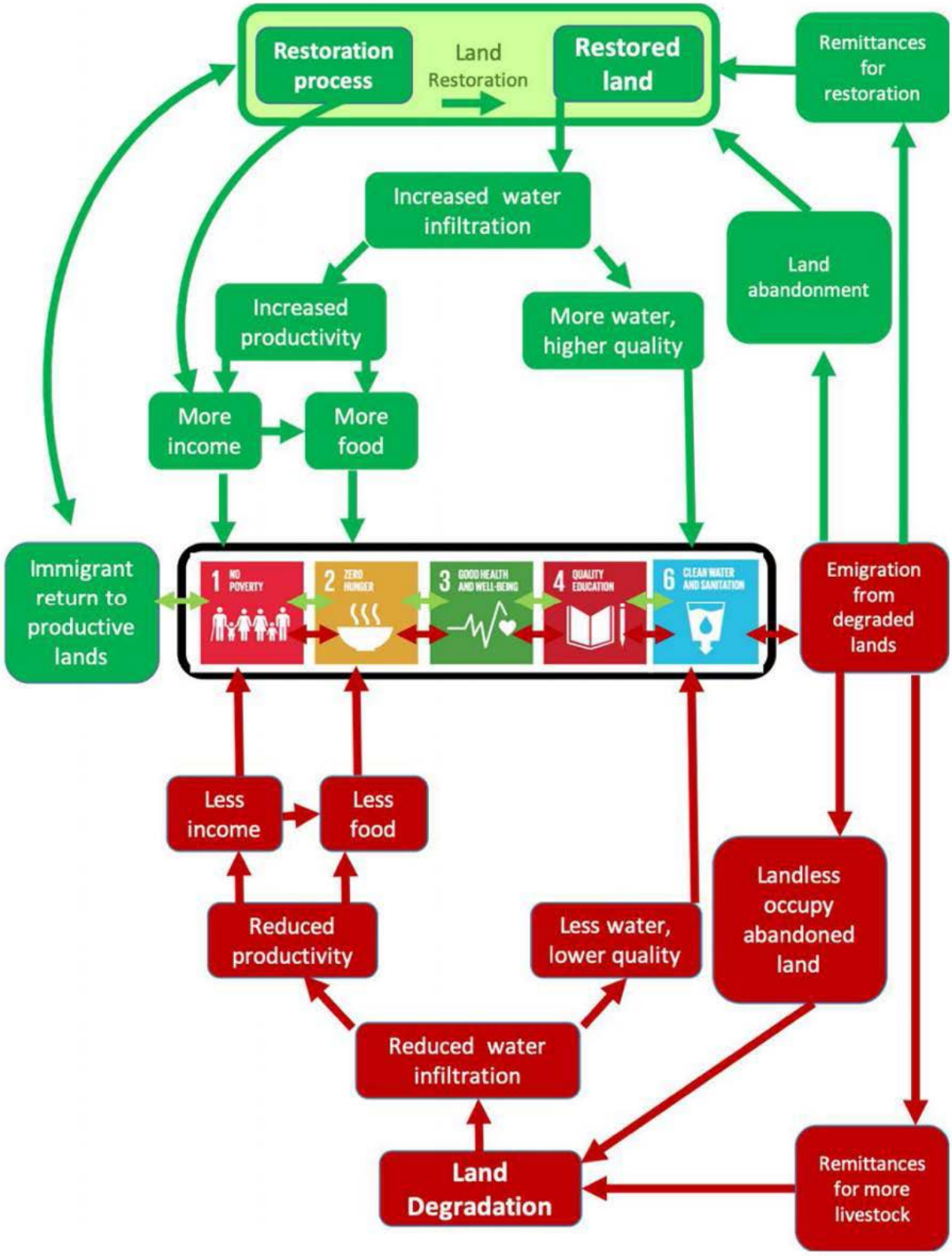

Figure 30. Land degradation, migration and restoration and the SDG nexus. Negative and positive policy feedbacks of remittances identified by IRP (2019)

6.3.1.6 Targeted development assistance policies and migration

The role of development assistance in mitigating migration has been debated as an alternative to stringent border control policies. In a large empirical study of country pairs involving 22 donors and over 150 recipients during 1993-2008, Bermeo and Leblang (2015) found that donors do "use foreign aid to achieve their broader immigration goals, targeting migrant sending areas to increase development and decrease the demand for entry into the donor country". Their study found a "statistically significant and substantively important" positive correlation with aid spending: the higher the number of migrants hosted from a particular country, the larger the allocation of aid to the sending country, and the levels of spending increased when migration policies in host states became more restrictive. They suggest this can be explained by: (i) donor desire or expectation that aid funding would decrease some of the driving forces behind migration in countries of net outwards migration; and (ii) the role of the diaspora in mobilizing/lobbying for increased allocations of aid resources. As the economy grows, migration can also grow and then eventually decline. The diaspora can also have more dynamic residency patterns in terms of country of origin and migration (particularly as migrants near retirement).

According to the statistical analysis of overseas development assistance (ODA) and migration by Lanati and Thiele (2017), there is "evidence of a negative relationship between ODA spending and emigration rates", even in the event of natural disasters (a conclusion shared by Beine and Parsons 2015). An important concept is the Migrant Labour Dependency Ratio (MLDR), which measures the extent to which the domestic population is dependent on migrant labour. It is calculated by dividing the domestic population not working by the migrant population that have migrated for work. A high dependency ratio indicates a scarcity of workers to support youth and older adults, either directly or through the tax system. Conversely, a low dependency ratio implies that there are a large number of working-age people at origin, which increases the likelihood of emigration. In the analysis by Lanati and Thiele, both effects are significant for the full sample but become insignificant at conventional levels when running separate regressions for richer and poorer countries.

Such research shows that donor policies related to migration in source countries need to be relevant to specific conditions, as well as being adaptable to particular dependency demographics. Another intriguing resource nexus to such migrant flows linked to labour supply is the scale of migrant agricultural workers worldwide – particularly from Central America to the United States. Despite a rise in automation, there is still considerable reliance on migrant workers in specific agricultural sectors such as food and vegetable horticulture. Human mobility patterns and policies that allow for such labour movements are thus essential for food resource security.

Side box 11: Nansen Initiative and the Platform on Disaster Displacement (PDD)

The Platform on Disaster Displacement (PDD) is an international initiative aimed at improving protection for persons displaced across borders in the context of disasters and climate change. Established in July 2016, PDD continues the work of its predecessor – the Swiss- and Norwegian-led Nansen Initiative - by supporting States and other stakeholders to strengthen protection and assistance for persons displaced across borders and to prevent or reduce disaster displacement risks. Its main goal is to support the implementation of the Nansen Initiative's Agenda for the Protection of Cross-Border Displaced Persons in the Context of Disasters and Climate Change (Protection Agenda). The Platform provides practical assistance, technical support and acts as a knowledge-sharing and advocacy platform across relevant policy and action areas and stakeholder groups (disasterdisplacement.org).

The Protection Agenda offers States a toolbox for responding to disaster displacement. Endorsed by 109 States in 2015, it identifies three priority areas for action: collecting data and improving knowledge; enhancing the use of humanitarian protection measures for cross-border disaster-displaced persons; and strengthening the management of disaster displacement risk in the country of origin. The latter may entail: integrating human mobility challenges within disaster risk reduction and climate change action strategies; facilitating migration with dignity as a potential way to cope with natural hazards and adverse effects of climate change; improving planned relocation as a preventative or responsive measure to disaster and displacement risk; and ensuring that the needs of internally displaced persons in disaster situations are specifically addressed.

Beyond the Protection Agenda, the PDD supports the implementation of the Sendai Framework for Disaster Risk Reduction (DRR) 2015-2030, the Paris Agreement under the United Nations Framework Convention on Climate Change (UNFCCC), the Global Compact on Refugees (GCR) and the Global Compact on Safe, Regular and Orderly Migration (GCM). In cooperation with a multitude of partners – including governments, the UN, international and regional organizations, academia and civil society – the PDD works to consolidate and enhance the use of effective practices and promote policy coherence. For example:

- In the Pacific region, the PDD is currently working on the Pacific Response to Disaster Displacement (PRDD) project, in collaboration with the Internal Displacement Monitoring Centre (IDMC), the International Organization for Migration (IOM) and European Union (EU). This project supports governments in planning for, preventing and responding to disaster displacement. It focuses on the collection, analysis and dissemination of disaster displacement risk data, the development of policies and frameworks addressing human mobility challenges and the development of country-specific tools to strengthen the operational preparedness and response capacity of governments in participating countries.
- The PDD is engaged in work in West Africa, alongside IOM and the United Nations High Commissioner for Refugees (UNHCR), to support States in West Africa in their efforts to minimize displacement and facilitate regular migration pathways in the context of disasters, climate change and environmental degradation. This project supports the implementation of State commitments as set out in the GCM and the African Union Three-Year Implementation Plan of Action for the GCM in Africa 2020-2022, among others.
- The Free Movement Protocol for the Intergovernmental Authority on Development (IGAD) region explicitly addresses disaster displacement and, at present, PDD is involved in a Migration Multi-Partner Trust Fund project based in the Horn of Africa IGAD region in partnership with IOM, the International Labour Organization (ILO), UNHCR, IGAD and the IGAD Climate Prediction and Application Centre (ICPAC). This joint programme seeks to build the capacity of national government officials in terms of preparedness when responding to disaster displacement. It will help to facilitate pathways for regular migration in the IGAD region and minimize displacement risk in the context of climate change, environmental degradation and disasters in line with the vision and guiding principles of the GCM.
- In the Americas, the PDD is working closely with the Regional Conference on Migration (RCM), the South American Conference on Migration (SACM) and their respective member countries to implement regional guidelines on admission and stay in disaster and climate change contexts. This includes supporting the development of national policy guidance on disaster displacement, for example with the Government of Chile and others. It is complemented by efforts to promote binational and regional simulation exercises to test the applicability of regional guidelines and the development of more specific Standard Operating Procedures (SOPs) on admission and stay.

Cutting across different regions, PDD supports the development and roll-out of tools supporting governments to include displacement considerations in their national and regional climate change, disaster risk reduction (DRR) and development planning. The Words into Action Guidelines and checklist (Disaster displacement: How to reduce risk, address impacts and strengthen resilience) is an example of such practical guidance. An e-learning tool is now also available to support States and DRR practitioners to systematically incorporate displacement considerations into regional, national, subnational and local DRR strategies. Led by the Norwegian Refugee Council (NRC), with the support of the German Federal Foreign Office, IDMC, the United Nations Office for Disaster Risk Reduction (UNDRR), IOM and UNHCR, this tool highlights the various roles that DRR and Disaster Risk Management (DRM) can play in reducing, preparing for and responding to disaster displacement to ensure that future DRR strategies across the globe include disaster displacement, as set out in the Sendai Framework.

6.3.1.7 Migration policies addressing disaster displacement

The Platform on Disaster Displacement defines disaster displacement as "situations where people are forced to leave their homes or places of habitual residence as a result of a disaster or in order to avoid the impact of an immediate and foreseeable natural hazard". As indicated in the systematic literature review, the numbers involved are the subject of speculation but estimates of tens of millions moving per decade on a temporary or permanent basis seem reasonable (ODI 2016). When assessed against environmental predictions, it is not unrealistic to expect that the frequency and severity of extreme weather events owing to climate change, as well as the societal, economic and resource pressures created, will continue to cause a notable movement of people in coming years and decades. The UN Human Rights Committee has noted that countries may not deport individuals who face climate-induced displacement. The Committee also clarified that individuals seeking asylum status are not required to prove that they would face imminent harm if returned to their countries, as it recognized that climate change-induced harm can occur both through sudden-onset events and slow-onset processes.

Since 1990, the United States has granted a form of humanitarian relief called Temporary Protected Status (TPS) to nationals of certain countries that have become embroiled in violent conflict or suffered a natural disaster. An estimated 400,000 people currently hold TPS status as of March 2022 (including those granted the status from Ukraine following the Russian Federation's invasion of the country).48 As the name implies, TPS does not permanent legal status in the United States. Recipients do not receive lawful permanent residence (a green card), nor does their TPS status make them eligible to apply for permanent residence or citizenship. Rather, TPS beneficiaries receive provisional protection against deportation and permission to work in the United States for a limited period of time. The United States can end a country's TPS designation once it has recovered from the triggering event.

The United States Congress created TPS in 1990 as a uniform system for granting temporary protection to people unable to return to their home countries because of a political or environmental catastrophe. Before 1990, the executive branch dealt with this scenario by designating certain countries for Extended Voluntary Departure (EVD), an administrative status that amounted to an exercise of prosecutorial discretion by the Attorney General not to pursue nationals of certain countries for removal if found to be living in the United States without authorization. However, there were no established criteria explaining how a country might qualify for EVD, and critics alleged that decisions regarding the grant of EVD to nationals of a particular country were often politically motivated. This argument became especially prominent in the late 1980s, when the Reagan administration decided not to designate El Salvador for EVD despite the country's ongoing civil war.

To resolve the controversy, Congress created TPS – a statutory mechanism for granting protection against deportation to nationals of designated countries. Under current law, the Homeland Security Secretary may designate a country for TPS when one of three circumstances occurs:

- There is "ongoing armed conflict" that creates unsafe conditions for returning nationals;
- There has been an earthquake, flood, drought, epidemic or other environmental disaster that makes the State temporarily unable to accept the return of its nationals, and the State has requested TPS designation; or
- "Extraordinary and temporary" conditions in a State prevent its nationals from returning safely.

Once a country has been designated for TPS, its nationals who are residing in the United States at the time of the designation may be granted protection if they meet certain criteria. These include having been continuously present in the United States from a date specified by the Department of Homeland Security (DHS), and having a relatively clean criminal record. Individuals who are granted TPS receive two main benefits: a reprieve from deportation and authorization to work. TPS holders may also apply for special permission to travel internationally and return to the United States. TPS does not confer permanent residency, citizenship or any right to ongoing immigration status (Messick and Bergeron 2014).

Although TPS is marginally restrictive in its criteria, support mechanisms and intended longevity, in numbers alone it is one of largest temporary displacement mechanisms worldwide. There has been some debate about the number of designated countries eligible for TPS and the length of time that people can reside in the United States (Wilson 2020).

48 Most current information on TPS can be found at: Temporary Protected Status | USCIS.

There is certainly a justifiable argument that the definitions and associated criteria for claiming might be re-evaluated in light of emerging understandings of the role of longer-term, more subtle accumulative processes in creating acute resource pressures, rather than considering disaster events alone.

6.3.2 Options for moving: policies for adaptation and sustainable resource use at destination

So far, the document has considered policies that might prevent changes in resource dynamics in places of origin in a context of resource pressures and associated socioeconomic circumstances. The second broad consideration related to places of destination for migration linked to resources. This may involve resources drawing people to access or exploit a particular type of resource. Examples include the mineral resource rushes that in the past and present have involved the movement of large numbers of people. However, approaches to manage the socioenvironmental dynamics of phenomena like artisanal mining are likely to be applicable to other types of resources in response to current or future resource demand or pressures. Consideration is also given to managing the movement of people away from areas of resource limitations in the form of resettlement to another country and the managed retreat of populations away from vulnerable areas within and across national borders.

6.3.2.1 Policies to manage migration flows from resource rushes

Natural resources are partly determined by physical geography, such that soil, minerals and water availability can determine the kind of economically viable activity that can be carried out in a given area. For renewable resources such as agriculture and forests, water and climate are the limiting factors that can constrain long-term habitability of human populations near the resource. If the land remains arable and water and climate temperature modalities are within viable ranges, human habitation can continue with each growing season. However, in the case of mineral resources, there are clearly more finite time horizons for human settlement in relation to the resource. Although some operations such as the mercury mines of Almaden in Spain have lasted for several hundred years, most mines last for only a few decades. Furthermore, minerals can occur in locations where arable land and water may not be readily available and hence human habitation can be constrained. Mineral deposits, particularly of gemstones and some precious metals, can also be discovered by itinerant miners. In these geographically specific locations, this can lead to "mineral rushes" and create a "boom and bust" human migration trajectory to communities in these regions. Policies around resource rushes have to be fine-tuned to these aspects of the mineral economy.

Temporary migrations linked to larger mineral extraction ventures can also lead to major secondary impacts on resources in remote sites. Historically, "boom towns" would emerge near these mineral rushes due to rapid migration and then go into rapid decline once the resources were depleted, leading to so-called "mining ghost towns". The Chamber of Minerals and Energy Western Australia (CMEWA) – a region which has seen more than its fair share of such of "Drive-in-Drive Out" (DIDO) or "Fly-in-Fly-Out" (FIFO) operations - contends that "the increase in FIFO employment in recent years has been driven by a tighter and more competitive labour market, increasing volatility in the resources sector, increased disparity between the relatively large construction workforces and smaller operational workforces in new projects, and increased dispersion of resources operations" (Morris 2012). Specific policies to limit disruptive cycles of ephemeral migration tend to focus on fostering more localized development of areas adjacent to mining operations, such as incentive packages to encourage industry workers to settle more permanently, and assurances and/or securing of funding for local service and infrastructure development (Morris 2012).

A case of resource rushes: formalization of artisanal mining

Artisanal and small-scale mining (ASM) tends to occur in impoverished parts of the world where poverty can lead to rapid mineral rushes if deposits of a precious mineral are found. Chapter 3 considers some geographic dimensions of these rushes. The scale and speed of these rushes can be highly anarchic and, in the absence of clear governance mechanisms, the migration of miners can lead to considerable resource impact in sensitive environments. The United Kingdom Government and the University of Dundee have formulated a series of recommendations to formalize artisanal and small-scale mining activities that can in turn lead to more effective management policies around such mineral rushes. Some of these key policy recommendations are summarized below:[49]

49 The policy recommendations are taken from the Extractives Hub and the Universities of Dundee, Centre for Energy, Petroleum and Mineral Law and Policy https://www.extractiveshub.org/topic/view/id/1/chapterId/420

1. Revised and improved licensing processes

Nearly every country with a notable level of ASM activity has licensing systems for the sector. However, the vast majority of artisanal mining operations continue in an unlicensed and transient way outside of legal frameworks and regulations. While the dynamics behind this trend vary by context, in simple terms most ASM remains informal because of there is little incentive to formalize it: obtaining a license is typically an outdated, overly costly and/or bureaucratic (and in some cases corrupt) process; due to a lack of governmental outreach there is little chance of being caught and punished for operating illegally; and, for the same reason, those who do operate legally receive little in terms of assistance and assurances. Streamlining the licensing process by making it faster, affordable, accessible (through decentralization and online procedures) and locally appropriate can help significantly with formalization.

2. Access to land and information

One of the most prevalent issues for more regulated ASM is a lack of access to or availability of land that is economically viable for ASM (Hilson and Maponga 2004). Without such information, artisanal miners are more likely to opportunistically prospect on agricultural land, conservation areas or encroach on large-scale mining concessions, increasing the mobility of people operating in an environmentally destructive way. Conducting or releasing existing data on geological prospecting and demarcating land specifically for ASM would help alleviate this by making miners' activities more permanent and discouraging transient mining practices. Many large-scale mining companies have been encouraged to cede areas of land that they are not planning to exploit to be worked on by artisanal miners instead. Much more action is needed on this front, as are additional initiatives by authorities to independently allocate areas for ASM.

3. Education, training and assistance

Although education and training would help with effective formalization, it is not necessarily legally or logistically feasible to arrange such provision for informal miners. Education and training can certainly encourage better mining practice, as evidenced by outreach through the Global Mercury Project, for instance (Huidobro et al. 2006; McDaniels et al. 2010). Developing accessible and appropriate technical and vocational education and training resources for miners should include information on safe working practices in terms of health and safety and the environment, coupled with more effective mining techniques. This would reduce the negative social and environmental impacts of operations and improve working conditions, yields and incomes.

4. Supporting miners in the field

Developing and maintaining support facilities for miners to receive and exchange information, lease or purchase good quality equipment and refine or process ores has long been advocated but rarely implemented effectively in practice (see Amoah and Stemn 2018). As with broader community interventions, it is essential that the needs of miners and dependents are properly assessed to ensure such support facilities meet their requirements and local contexts. Creating central hubs of mining activity might also consolidate the settlement of miners to more limited geographical areas.

5. Improved institutional capacity

As implied above, the informality of the ASM sector is not simply a wilful avoidance of formal channels and regulations. Rather, much of it stems from a lack of outreach from mandated authorities to assist and enforce. Typically, in mineral-rich lower income countries where ASM is most prevalent, the artisanal mining governance is more or less an afterthought to regulation of the large-scale mining sector (Hilson and McQuilken 2014). A long-overdue strengthening of government departments and institutions will be essential if a meaningful formalization of ASM is to encourage effective collaboration and coordination of different ministries and departments at the local and national levels.

6. Better monitoring and enforcement

Manpower and resources available to artisanal mining regulators are, without exception, woefully inadequate (Clifford 2014). There needs to be a significantly increased capacity of government agencies to better monitor and consistently enforce ASM activities, on the one hand, and assist miners with training, education, compliance and positive working relationships, on the other. Ensuring artisanal mining is confined to designated areas and that it uses best practice reduces the transience of the sector and offers more protection against the degradation of surrounding resources like agricultural lands and water catchment systems.

7. Revision and formulation of ASM policies

In addition to being poorly enforced, ASM regulations in many countries are outdated and inappropriate, having been formulated during much earlier policymaking consultations with the multilateral or bilateral partners, or having been modelled on large-scale processes or imported verbatim from other countries. A new period of consideration is certainly required to ensure that existing laws and regulations are still functional, feasible and sufficiently in tune with ASM activities and local contexts.

8. Improve the involvement of ASM associations and cooperatives

Any attempt to successfully drive formalization and its associated reforms should, of course, involve coordination with artisanal miners expected to comply. This poses a significant challenge in many contexts, such as sub-Saharan Africa, because artisanal mining is often transient and unorganized. However, in other locations such as South America, a longer-standing tradition of collective action has seen the formation of well-organized ASM associations that have been beneficial to miners and policymakers alike: they provide a single entity with which to engage and consult on matters and a forum for the exchange of knowledge. Encouraging more widespread organization and representation of ASM communities would be a significant advantage to formalization processes.

While the example of ASM might appear to be relatively specialized, in other cases, different resources may encourage migration and resulting pressure or competition with other resource uses. One example would be a poorly managed expansion of agricultural land in a previously unused area, for example. This might involve the same movement of people seeking to take the opportunity to use these resources, and a struggle to effectively oversee and legislate for this new development depending upon the context.

6.3.2.2 Planned relocation policies

Planned relocation, or resettlement, policies – that is, "the transfer of people from an asylum country to another State, that has agreed to admit them and ultimately grant them permanent residence" (UNHCR 2021) – is nothing new, having been implemented since at least the First World War (Nawyn 2012) when groups and individuals escape social, economic and political persecution and desperation. This report and others have suggested that contemporary and future resource pressures may, in certain circumstances, contribute to the number of people seeking resettlement. There are immense sensitivities about what constitutes voluntary resettlement in the context of "environmental migration" (Ransan-Cooper et al. 2015; Thornton et al. 2019; Farbotko et al. 2020). Policies need to adhere to relevant global standards from a range of United Nations bodies. Best principles and practices can be drawn from emerging policymaking literature on this subject and empirical example of resettlement approaches in practice. While currently applicable only to internal relocation, the principles from the Guidance on Planned Relocation (see below) could serve as a solid conceptual and practical foundation for resettlement policies across nations:o:

1. Planned relocation is undertaken for the benefit of relocated persons and in a manner that respects and protects their rights and dignity.

2. States bear the primary responsibility under international law to respect, protect and fulfil the human rights of people within their territory or subject to their jurisdiction. This includes the obligation to take preventive as well as remedial action to uphold such rights and to assist those whose rights have been violated.

3. States must have compelling reasons, robust evidence and a sound legal basis for undertaking planned relocation.

4. States should ensure sufficient and sustainable funds for planned relocation.

5. Persons or groups of persons at risk of, or affected by, disasters and environmental change should have the right to request planned relocation, as well as the right to challenge planned relocation before a court of law.

6. Planned relocation should be used as a measure of last resort, after other risk reduction and/or adaptation options have been considered in a timely manner and reasonably exhausted.

7. Planned relocation should be carried out within a rights-based framework that safeguards both individual and collective civil, political, economic, social and cultural rights of relocated persons and other affected persons throughout all phases. The rights to self-determination, preservation of identity and culture and control of land and resources are important, particularly for indigenous communities.

8. Relocated persons and other affected persons should be informed, consulted and enabled to participate in decisions on whether, when, where and how a planned relocation is to occur, as appropriate.

9. The agency, resilience and empowerment of relocated persons should be recognized, promoted and enhanced throughout a planned relocation.

10. The specific rights, needs, circumstances and vulnerabilities of relocated persons and other affected persons, as applicable, should be taken into consideration and addressed in all phases of a planned relocation. These specific rights, needs, circumstances and vulnerabilities, may be linked, inter alia, to:

    (a) demographic and health characteristics;

    (b) socioeconomic characteristics;

    (c) membership of a marginalized group;

    (d) special dependency on, and/or attachment to, land or local/localized resources/ opportunities;

    (e) direct and indirect impacts of disasters or environmental change;

    (f) or prior experiences of displacement.

11. Planned relocation should provide opportunities and conditions to:

    (a) enable relocated persons to improve, or, at a minimum restore, their living standards;

    (b) enable host populations to maintain their pre-existing living standards, or to attain the same living standards as relocated persons, whichever is higher; and

    (c) mitigate adverse impacts related to the planned relocation that may affect persons who live in close proximity.

12. Planned relocation shall be carried out in a manner that respects and upholds the principle of family unity. Planned relocation should also be carried out in a manner that respects and maintains household, community and social cohesion, as well as kinship ties.

13. Relocated persons shall:

    (a) enjoy, in full equality, the same rights and freedoms under international and domestic law as other similarly situated persons in their country;

    (b) not be discriminated against in the enjoyment of any rights and freedoms on the grounds that they have taken, or will take, part in a planned relocation; and

    (c) have the right to freedom of movement and the right to choose their place of residence.

Notwithstanding these guidelines, there are a range of examples of mismanaged relocations that have exacerbated natural resource degradation. For example, a long-range study on the impact of a series of planned relocation programmes in south-west Ethiopia from the 1950s found that over five decades there was substantive forest loss that could be directly attributed to establishment of migrant settlements in areas unsuitable for prevailing livelihoods like agriculture. Results from the forest cover change analysis revealed that the study area lost large tracts of its forest cover (80%) between 1957 and 2007. Demographic, socioeconomic and cultural changes introduced by migrants were the leading drivers of deforestation in the study area (Getahun 2017). The loss was greater than if the population had not been resettled, because of resulting changes in livelihoods towards intensive cereal cultivation and lack of resilience in livelihoods.

Side box 13: Ecological migration / relocation policy in China

The term "ecological migration" is used in China as a means of linking resource constraints to State-planned relocation. China's State Forestry Administration estimates that nearly 20% of the country has been impacted by some form of desertification, with another 310,000 square kilometres likely to suffer in the near future. These environmental changes, coupled with industrialization and other anthropogenic activities, have been a key driver behind many people migrating in Inner Mongolia, Xinjiang, Tibet and Ningxia Hui autonomous regions, as well as Gansu and Qinghai provinces. Considerations of how to manage ecological migration in China began in the early 1980s, with central Government exploring the options for three regions in Gansu and Ningxia Hui autonomous region that appeared to be struggling with poverty and desertification.

China's policy objectives with regard to ecological migration go beyond simply migration to survive (生存性移民), ranging from environmental protection and restoration of ecologically fragile areas to attending to the long-term opportunities and prosperity of migrants (Wu 2019). There is an emphasis on the fate of areas of inwards migration: ecological migration should not endanger the ecological environment of destination areas nor compromise the socioeconomic dynamics of existing local residents. Infrastructure development to complement China's rapid socioeconomic growth has also been a factor in displacement. Construction of dams for energy and water resources is relevant here: by 2018, over 98,800 dams had been constructed, with a total storage capacity of nearly 900 billion cubic meters (Chen et al. 2020). As elsewhere in the world, dam development in the country has not been without controversy: major protests against the Pubugou Dam in Sichuan Province in 2004 put dam resettlement on the national agenda (National Natural Science Foundation and Chinese Academy Sciences 2016). This led to a major rethink of how planned relocation should take place, and a re-examination of what had happened in past projects. A National Development and Reform Commission was established. Discussions led to a rethink of the philosophy and policies relating to relocation. Fundamental changes included: a commitment to implement relocation ahead of any project and to integrate it into project planning; people could no longer be marginalized for the sake of development – they had to be treated fairly; relocation changed from expropriation to a process of negotiation; the host community were also included as project-affected peoples and had to be beneficiaries; and the process of resettlement became more people oriented and more social, with all aspects of social being considered in relocation planning and implementation (Chen 2020).

The result of this policy consultation was the Post-Resettlement Support (PRS) Policy. Since its adoption in 2006, Chen et al. (2020) suggest that China's PRS and its associated Fund constitute a turn towards social sustainability in major infrastructure development and have proven to be effective in providing positive outcomes in communities resettled as a result of hydropower project development. The PRS is split into two components: the first provides compensation and pre-settlement; the second provides ongoing post-relocation support through direct financial support (cash payments) and social investments (agricultural and civic infrastructure, environmental protection and skills and training). Another notable facet was the extension of resources to people who had been resettled prior to its inception, in recognition of the relative harshness of previous relocation initiatives. From 2007 to 2017, over US$36 billion was allocated for PRS activities. Evidence indicates that the income and living conditions of resettled groups in China were improved after implementation of the PRS Plan and the Infrastructure Construction and Economic Development Plan.

Due to the long-standing nature of planned relocation policies, combined with the need to refine them over the last couple of decades in the light of turbulent global events, the ideal policymaking approach is already relatively well defined and has been the subject of much research (see Tadgell et al. 2018). However, the incorporation of resource-based claims for planned relocation are incomplete within current international frameworks. What emerges from the practical policymaking experience (IOM 2019) is that planned relocation cannot end with the process of moving people from place to another. Instead, there must be long-term consideration and commitment for promoting positive and lasting social, economic and environment outcomes.

6.3.2.3 Managed retreat policies

Managed retreat approaches can be thought of as "the purposeful, coordinated movement of people and assets out of harm's way" (Carey 2020). While by no means a new concept, pervasive slow environmental change indicates the high likelihood that more people are going to have to move and on a longer-term (or permanent) basis. Thanks to the availability of climatic data and modelling, many modern retreat policies are being devised proactively rather than reactively.

Coastal retreat strategies

Coastal areas and their communities are some of the most vulnerable locations for degradation of land and resources, and are therefore at a comparatively advanced stage of managed retreat planning. Georgetown University's Climate Center outlines several measures and regulatory tools that can be used separately or in combination for managed retreat in coastal areas. Such efforts are also aligned with the growing policy literature on nature-based solutions.

Living shorelines: Traditional approaches o protecting coastal development from flooding and erosion have focused on hard armouring – physical infrastructure like seawalls and breakwaters. Increasingly, however, coastal states and communities are turning towards living shorelines or soft armouring techniques such as dune creation and wetland restoration. As well as preserving many of the biodiversity and aesthetic components of coastal environments, this approach also avoids the more explosive negative impacts of hard armouring structures that can rapidly flood and erode surrounding properties and beaches if they fail or are breached.

Setback and buffers: A setback is a mandated distance for a structure behind a baseline location such as a tidal line, or a natural protective feature like a coastal dune, wetland or floodplain. In a similar fashion, buffers and buffer zones restrict property development to preserve important natural protective functions.

Development permit conditions: Involves placing longer-term conditions on coastal property development, with the expectation from both government and civilians that development will probably eventually need to relocate due to future coastal change. Levels of government might stipulate in coastal management and/or zoning codes that existing and planned properties must relocate if compromised by certain events such as beach or cliff erosion or permanent shifts in tidal lines.

Zoning and overlays: Similar to above, local governments can consider using zoning and overlay zones to support goals related to managed retreat, including phasing out or reducing development in vulnerable coastal areas by attempting to shift density and new development in higher ground areas. Overlay zones or districts can impose additional regulations on an existing zone based on its special characteristics for the purposes of natural, historical or cultural resource protection.

Room for the River Programme

A significant proportion of the Netherlands is situated on the deltas of several large rivers including the Rhine, Meuse, Scheldt and Waal. Almost a fifth of the country's landmass is made up of reclaimed land and a quarter lies below sea level. Land reclamation began as early as the twelfth century in response to land-use practices that resulted in the degradation and subsidence of the underlying peat or clay soils, causing significant amounts of flooding and land loss (de Mulder et al. 1994; Hoeksema 2007). Despite a longstanding history of flood management, around two thirds of the country is still at risk of flooding during storm surges and heavy precipitation events (van Alphen 2020).

High-water events were recorded in 1993 and 1995. The latter resulted in the evacuation of a quarter of a million people (and a million head of livestock). This prompted the introduction in 1996 of measures to adapt to adverse climate change and to provide more sustainable protection from floods. The Room for the River (RftR) Programme began in 2007, with the goal of managing higher river levels by lowering flood plains, creating water buffers, relocating levees, increasing the depth of side channels and constructing flood bypasses (Figure 31). The Programme consisted of 39 projects that were completed by the end of 2018.

A central concept behind the RftR initiative was partially recreating the floodplains of rivers like the Rhine rather than attempting to manage them. The aim was to reduce water volumes elsewhere in the country's various watersheds. This shift in approach meant that the risks of flooding would significantly increase for residents of certain areas. One well-documented example is the Noordwaard, an area of

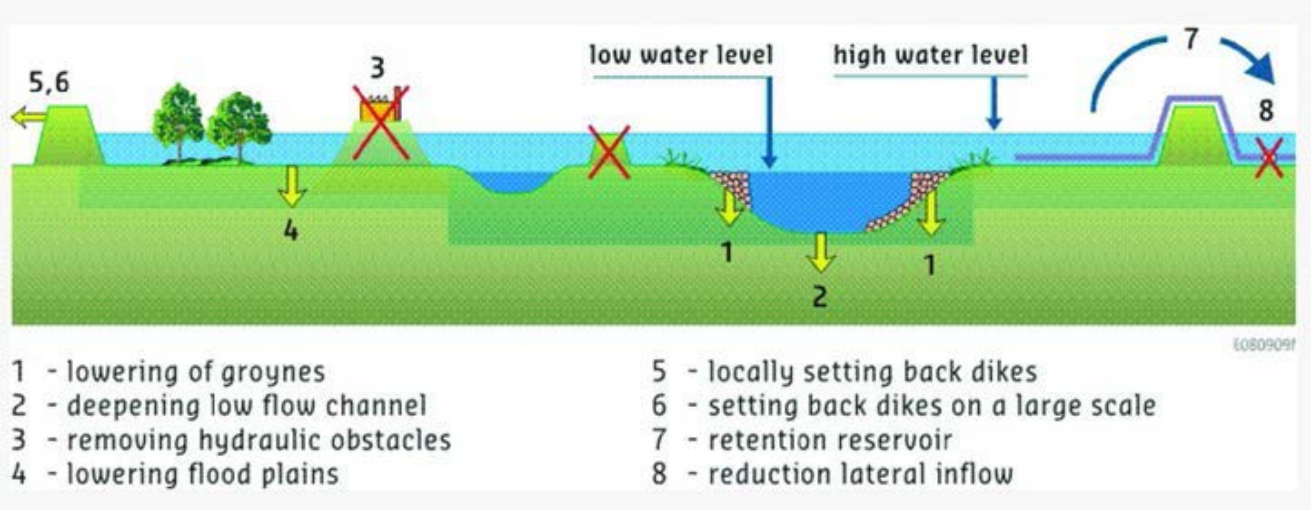

Figure 31. Room for the River Measures (van Alphen 2019).

mainly agricultural land with around 75 residents to the south east of Rotterdam. Under RftR, Noordwaard would no longer be behind a dike, significantly increasing the likelihood of flooding.

A participatory consultation process took place involving the authorities and Noordwaard's residents throughout the RftR project. Of the 25 farmers who participated in the decision-making, 15 left the area because there would no longer be enough agricultural land and were helped to find new farmland. Of the remaining 50 families, about half moved due to the danger of flooding. Residents wishing to relocate were offered the opportunity to sell their homes at market value. Those who chose to remain were entitled to compensation for moving to higher ground or taking measures for improved protection against high water levels. Today, the Noordwaard allows for controlled inundation of its 4,000 plus hectares and features an award-winning array of dikes, bridges and pumping stations that facilitate mixed recreational, residential and agricultural land use (https://landezine-award.com/noordwaard/).

A new Indonesian capital?

In August 2019, Indonesian President Joko Widodo announced that the country's national capital would move from Jakarta, on the island of Java, to the province of East Kalimantan, on Borneo, almost 1,000 km away and at a cost of almost US$33 billion. Originally intended to begin in 2020, the process was delayed until 2022 or 2023 to tackle the COVID pandemic.

The highly ambitious plan has been tabled more than once because of the many environmental issues and resource strains facing Jakarta, which is one of the most densely populated cities in the world (home to 10.5 million people) and responsible for two thirds of Indonesia's GDP (Salim and Firman 2012; World Bank 2019). Jakarta's population has grown by an estimated seven million people due to immigration in the past decade (World Bank 2015) and around half of the city's population live in slums. Air quality due to traffic congestion, coal-fired power plants, burning of domestic waste and deforestation in the surrounding regions has been a persistent issue (Van de Vuurst and Escobar 2020). Perhaps most significant, overextraction of groundwater has resulted in the city sinking by four metres since the late 1970s (Abidin et al. 2011) making it highly vulnerable to flooding (like the disaster that displaced hundreds of thousands of people in early 2020). In addition, there are broader sustainability concerns stemming from the fact that the surrounding island of Java has lost 40% of tropical forest and is expected to lose a similar percentage of its biodiversity in the coming decades (Higginbottom et al. 2019; Sodhi et al. 2004).

On the subject of the relocation, Van de Vuurst and Escobar (2020, p. 2) made the valid point that "though made in the good faith of relieving Jakarta of its human burden, could mean that the negative factors driving poor sustainability on Java could be transferred from Jakarta to Borneo". This concern has been raised many times. In fact, Borneo may be even more vulnerable than Java in terms of sustainability and resources. Borneo's environment has been heavily degraded by logging, mining and agricultural expansion in a way that seriously threatens its significant biodiversity and great number of endemic species (Edwards et al. 2020; Gaveau et al. 2016; Margono et al. 2014; Myers et al. 2000).

In response almost entirely to environmental and resource pressures, "Indonesia's announcement to relocate their political capital is [also] one of the first examples of government sanctioned, systematic, tractable, mass migration expected to occur in the modern Anthropocene" (van de Vuurst and Escobar 2020, p. 2). Regardless of the outcome, it would represent a seminal empirical study of a managed relocation on a mass scale.

6.3.2.4 UNFCCC Loss and Damage Framework

While the United Nations Framework Convention on Climate Change recognizes climate-induced migration as an effective adaptation strategy in the 2010 Cancun Adaptation Framework, existing international policy frameworks do not provide enough help and protection for people moving because of climate change impact. For example, the 1951 Geneva Refugee Convention and its 1967 Protocol do not recognize climate change as a reason for granting refugee status. Also at the national level, there are hardly any examples of legal frameworks that grant protection to "climate refugees" and support relocation in line with their needs. The following international instruments are important in this regard:

- The United Nations Framework Convention on Climate Change (UNFCCC) Task Force on Displacement, created under the Warsaw International Mechanism for Loss and Damage associated with Climate Change Impacts (WIM);
- Regional relevant policy discussions under the Economic Community of West African States (ECOWAS) and the Intergovernmental Authority on Development (IGAD);
- The Almeria Conference on Desertification and Migration.

In some contexts, mitigation efforts have failed or are likely to fail to prevent ongoing anthropogenic pressures on natural resource stocks and environmental conditions. This makes adaptation unfeasible. Vulnerable nations have insisted that existing frameworks are inadequate to protect their environmental futures and have called for an international mechanism to deal with residual loss and damage. The UNFCCC, which established the WIM in response to such concerns, defines loss and damage as "the actual and/or potential manifestation of impacts associated with climate change in developing countries that negatively affect human and natural systems" (as quoted in James et al. 2014). However, as highlighted by Roberts and Andrei (2015, p. 261), it is extremely complex to establish these and then to quantify them:

> *"Loss and damage that is not avoided is categorized as either economic or non-economic loss and damage. Economic loss and damage – including loss of gross domestic product (GDP) and loss and/or damage to physical assets – is accounted for in formal accounting processes (Morrissey and Oliver-Smith, 2013). Non-economic losses such as the loss of lives, traditional or indigenous knowledge, ecosystem services and cultural, social and psychological impacts, are not accounted for in formal accounting process and therefore are more difficult to both measure and address".*

The WIM aims to assist developing countries that are particularly vulnerable to the adverse effects of climate change by: enhancing knowledge and understanding of comprehensive risk management approaches to loss and damage; strengthening dialogue, coordination, coherence and synergies among relevant stakeholders; and enhancing action and support including finance, technology and capacity-building (UNFCCC 2021). Their five strategic work streams address slow-onset events, non-economic losses, risk management approaches, action and support plus human mobility.

Despite the fact that the importance of addressing loss and damage has been reaffirmed with the 2015 signing of the Paris Agreement and at each Conference of the Parties (COP) since, the specific mechanisms for economic and non-economic loss and damage have proven politically controversial. This has hampered their conception, development and policy implementation (Carbon Brief 2017; Mace and Verheyen 2016). Unlike the other two pillars of the UNFCCC - mitigation and adaptation - with US$100 billion a year promised in financing, there is currently no clear policy framework, funding or governance for loss and damage. As shown in Table 5 below, relevant discussions at the last COP included demands from lower- and middle-income States for much more tangible action (Pierre-Nathoniel et al. 2019). The next official review of the WIM has been set for 2024.

Suggestions of any form of reparation between countries can inevitably be a source of controversy in the international policymaking arena. However, it seems questionable to address current and future environmental and resource dynamics (including consensus on mitigation and adaptation within UNFCCC frameworks) without dealing with current degradation of resources. If one aim is to prevent forced displacement resulting from resource shifts and degradation, then it would make sense to support countries that are at a disadvantage in this regard.

Requests by G77+China	Achievements	Shortcomings
Call for urgent, scaled up, new and additional finance by developed countries	• Several paragraphs on finance are included in the decision • Closer linkages of the WIM ExCom to the SCF • Entry point for ExCom to work with GCF to include loss and damage • Recognition of the urgency of enhancing the mobilization of action and support, including finance, technology and capacity-building, for developing countries. • Inclusion of a broad range of players[1] in the need to scale up support for loss and damage	• Non-consensus to specifically reference the developed country obligation to provide new and additional finance
Establishment of an expert group on action on support	• Establishment of the expert group under the WIM ExCom by the end of 2020 • Expert group charged with following up on the provisions relating to the SCF and the GCF • Inclusion of tasks of expert group of collection, compilation and dissemination of information on the available sources of support under and outside the Convention, facilitates the distilling of the various finance-related papers produced through the ExCom between 2016 and 2019, with a view to making recommendations for focused action	• Shortcoming of task list in covering all desired asks for the expert group, such as facilitating a needs/gap analysis
Establishment of the Santiago Network for Averting, Minmizing and Addressing Loss and Damage	• Provision of technical assistance to developing countries through a network of relevant bodies, institutions and organizations	• No concrete timeline agreed for operationalizing the network
Dual governance of the WIM under the Convention and the Paris Agreement	• Clear signaling, through appropriate wording, of no resolution to the governance issue and that issue will be further discussed next year	• WIM review decision under Paris Agreement

Table 5. Policy action evaluation on WIM from 2019 COP (Nathoniel 2019)

6.4 Transformative potential of these policy approaches

The policy approaches discussed have been relevant to the ethical frameworks and policymaking blueprints for managing the links between resources and migration. Examples include the idea of mobility justice; the Global Compact for Safe, Orderly and Regular Migration; concepts of climate mobility reparations; and cautious caveats to adaptive policies.

6.4.1 Policy guidance approach: towards mobility justice within resource constraints

As a starting point, the concept of mobility justice provides a framework for considering migration and natural resources in terms of social and development policy. Key elements of this approach have been highlighted by sociologist Mimi Sheller (2018) as follows:

1. All people shall enjoy a right to exit and re-enter the territory from which they originate;
2. There is a right to refuge for those fleeing violence, persecution and loss of domicile through war;
3. People displaced by climate change shall have a right to resettlement in other countries, especially in those counties that contributed most to climate change; New Zealand's prospect for validating a "climate passport" for vulnerable island populations may be considered an example in this regard;45
4. There is a right to freedom of movement across borders for any temporary purpose defined by law (tourism, education or temporary work);
5. No one should be detained or deported without due process;
6. Immigration law shall not be used to exclude entire categories of persons on the basis of race, religion, ethnicity, nationality, sexuality or health status.

Having such a foundational ethical framework for policy aspiration can be instructive as policymakers consider more specific operational principles. Sheller's approach has come under some criticism for being Utopian and disconnected from some urgent issues arising from living in the Anthropocene (Baldwin et al. 2019). Migration policies tend to be based on economic and employment factors more than any other variable. Most surveys justify this focus on the

basis that migrants themselves cite the importance of economic factors in their decisions. For example, a survey conducted by Adger et al. (2019) found that, out of a sample size of 1,668 migrants in India, Bangladesh and Ghana, 62% listed economic factors (employment and debt) as primary reasons for migration; followed by 33% for social factors (education, marriage or health); 3% for environmental factors (loss of income due to land degradation, extreme events or loss of seasonal income); and finally 2% for cultural or religious reasons.

Migration is explicitly mentioned in the following targets of the United Nations Sustainable Development Goals (SDG), which are important motivators of policy reform as part of the United Nations agenda for 2030:

SDG 8 - Target 8.8: "Protect labour rights and promote safe and secure working environments for all workers, including migrant workers, in particular women migrants, and those in precarious employment".

SDG 10 - Target 10.7: "Facilitate orderly, safe, regular and responsible migration and mobility of people, including through the implementation of planned and well-managed migration policies".

SDG 10 - Target 10.c: "By 2030 reduce to less than 3% the transaction costs of migrant remittances and eliminate remittance corridors with costs higher than 5%".

SDG 17 - Target 17.18: "By 2030, enhance capacity-building support to developing countries, including for least developed countries and small island developing States, to increase significantly the availability of high-quality, timely and reliable data disaggregated by income, gender, age, race, ethnicity, migratory status, disability, geographic location and other characteristics relevant in national contexts".

Indirectly, some goals of the mobility justice framework are also enshrined in major international migration initiatives such as the Global Compact on Migration.

6.4.2 Global Compact for Safe, Orderly and Regular Migration

The Global Compact on Migration is consistent with target 10.7 of the 2030 Agenda for Sustainable Development in which Member States committed to cooperate internationally to facilitate safe, orderly and regular migration, and its scope is defined in Annex II of the New York Declaration. It is intended to:

- Address all aspects of international migration, including the humanitarian, developmental, human rights-related and other aspects;
- Make an important contribution to global governance and enhance coordination on international migration;
- Present a framework for comprehensive international cooperation on migrants and human mobility;
- Set out a range of actionable commitments, means of implementation and a framework for follow-up and review among Member States regarding international migration in all its dimensions;
- Be guided by the 2030 Agenda for Sustainable Development and the Addis Ababa Action Agenda; and
- Be informed by the Declaration of the 2013 High-Level Dialogue on International Migration and Development.

This United Nations framework was adopted in December 2018 and focuses on evidence-based policy. It recognizes that human mobility is inherently dynamic and complex, and that policy must be adaptive based on the most recent data (Kraly and Hovy 2020). While the GCM has been criticized for not being legally binding, it has been praised for its "relevance, capacities, and legitimacy to become a normative force in the field of international migration governance" (Höflinger 2020).

From the Compact's 23 objectives, objective 2 ("Minimize the adverse drivers and structural factors that compel people to leave their country of origin") and objective 5 ("Enhance availability and flexibility of pathways for regular migration") would seem most relevant for the resources-mobility nexus. How international policymakers transform these ideals into sustainable resource management will be a central question in the coming years.

Some of the points raised by the Global Compact on Migration can also be implemented through regional mechanisms such as the Arctic Council or the SIDS Accelerated Modalities of Action (SAMOA) Pathway. There may also be links with the United Nations Permanent Forum on Indigenous Peoples.

6.4.3 Policies on climate mobility reparations

There are two possible pathways in terms of climate reparations. The first is known as "corrective justice" and refers to a negotiation between governments within an international jurisdiction. Under this scenario, the collective moral responsibility of high greenhouse gas emitters to compensate climate creditors forms the legal basis for holding high-emitting States morally accountable for a calculable and bearable share of the harms of climate change. This approach offers a financial mechanism for receiving migrants through an international Green Climate Fund.

Climate reparations between nations would enable "creditor countries"—such as small island States—to strengthen their resilience by funding disaster risk reduction, insurance and adaptation to help people remain in place. One practical mechanism would be an international compensation commission, which would receive claims from countries incurring adaptation expenses based on the United Nations Claims Commission – which was established after the first Iraq War to handle claims against Iraq for war-related damages.

The second pathway to climate compensation is through tort litigation for loss and damage against the major fossil fuel companies – in other words, suing the oil companies. A tort is an act or omission that gives rise to injury or harm to another. Through class action law suits filed under multiple jurisdictions, reparations could be sought for those harmed by greenhouse gas emissions, and corporations could be held responsible for specific injury, especially if it had been covered up (a strategy that worked against tobacco companies). According to Margaretha and Salili, "The call for compensation for loss and damage is also supported by well-established rules and principles of international law, including the right to reparations for injury resulting from violations of international law". According to their legal arguments on behalf of the low-lying vulnerable country of Vanuatu, the Warsaw International Mechanism for Loss and Damage offers the best opportunity for loss and damage finance, under the auspices of the United Nations Framework Convention on Climate Change.

6.4.4 Maladaptation: a cautionary note on adaptive policies

In the context of environmental and resource pressures within socioenvironmental systems, adaptation (a process of change in response to an ongoing environmental stimulus) is not intrinsically good per se or more broadly. For climatic or resource concerns, the scope for maladaptation is an area of growing concern. Juhola et al. (2016) define maladaptation as "actions that may lead to increased risk of adverse climate related outcomes, increased vulnerability to climate change, or diminished welfare, now or in the future". According to Schipper (2020), maladaptation is at one end of a spectrum of potential outcomes where, through inaction or inappropriate action, there is a departure from circular system of coping with ongoing change (Figure 32).

Barnett and O'Neill (2010) suggest five key pathways for maladaptation, with the final four being highly relevant to the resource and migration nexus:

(i) Those that increase GHG emissions

(ii) Those that disproportionately affect vulnerable groups or populations

(iii) Those that have high opportunity costs[50]

(iv) Those that reduce the incentive for further adaptation

(v) Those that encourage trajectories that reduce the possibility of adaptation for future generations.

Unfortunately, there are few frameworks that facilitate an understanding and identification of the risks and forms of maladaptation. Magnan and Mainguy (2014) form an overall assessment framework based on Barnett and O'Neill's typology within what they call the pathways framework and Hallegatte's (2009) proposed strategies towards climatic uncertainty within the precautionary framework (Figure 33, below). They suggest that the 11 practice-oriented guidelines could form a firm basis for assessing ex-ante analysis of adaptation initiatives and ex-post evaluations, with the aim of deriving firmer qualified indicators.

Building on the idea that there are few integrated frameworks for conceptualizing maladaptation, Magnan et al. (2016) suggest that "despite growing efforts worldwide to adapt to climate change, there appears to be little concern about the risk of maladaptation. There is a real possibility, however, that initiatives taken in the name of adaptation might not only waste financial resources but could also aggravate the consequences of one-off and gradual climate-related changes". The authors cite the following case studies (also see Eriksen et al. 2021):

50 That is, the loss of potential gain from other alternatives when one particular alternative is chosen

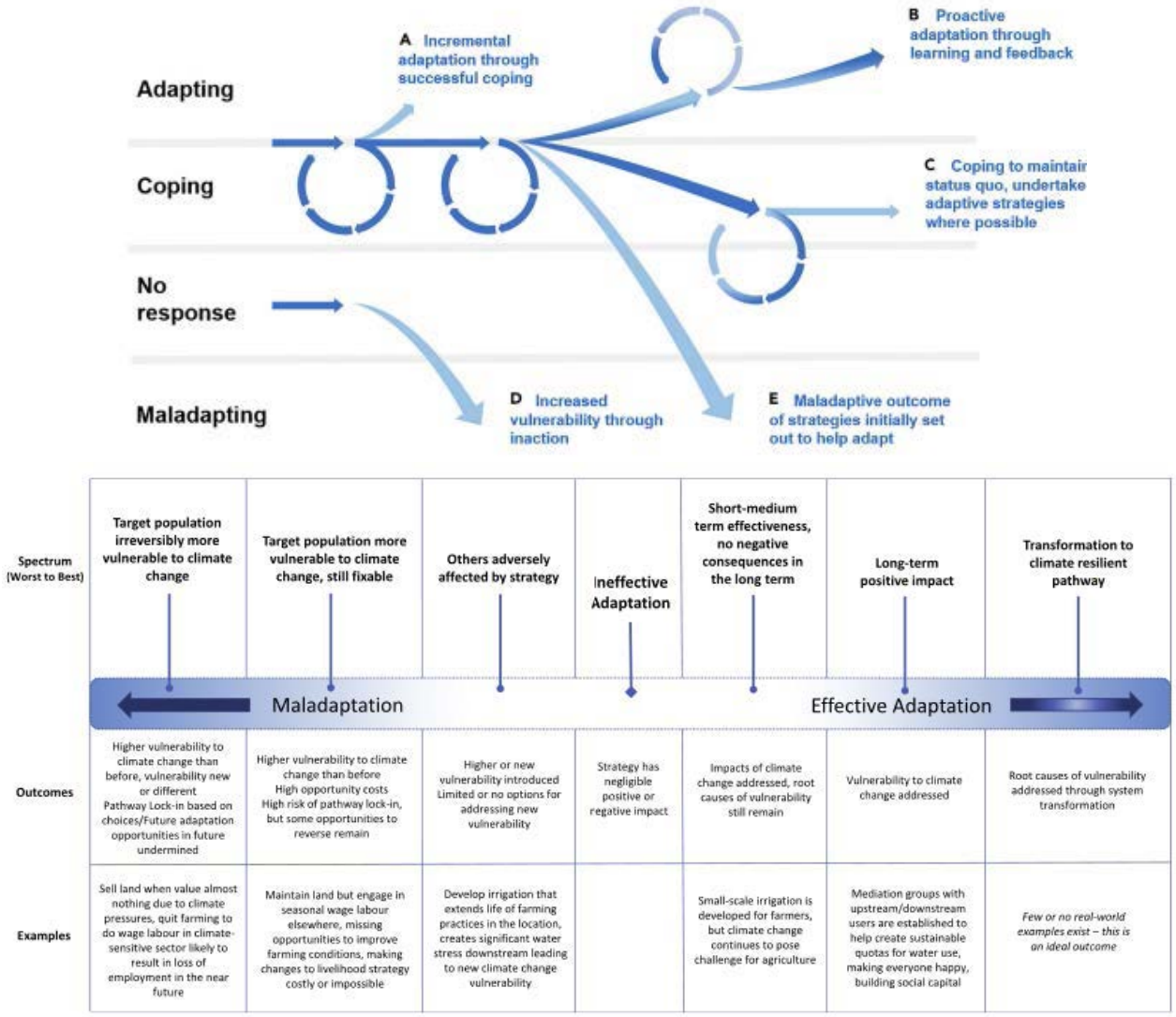

Figure 32. The spectrum of maladaptation to adaptation (Schipper 2020)

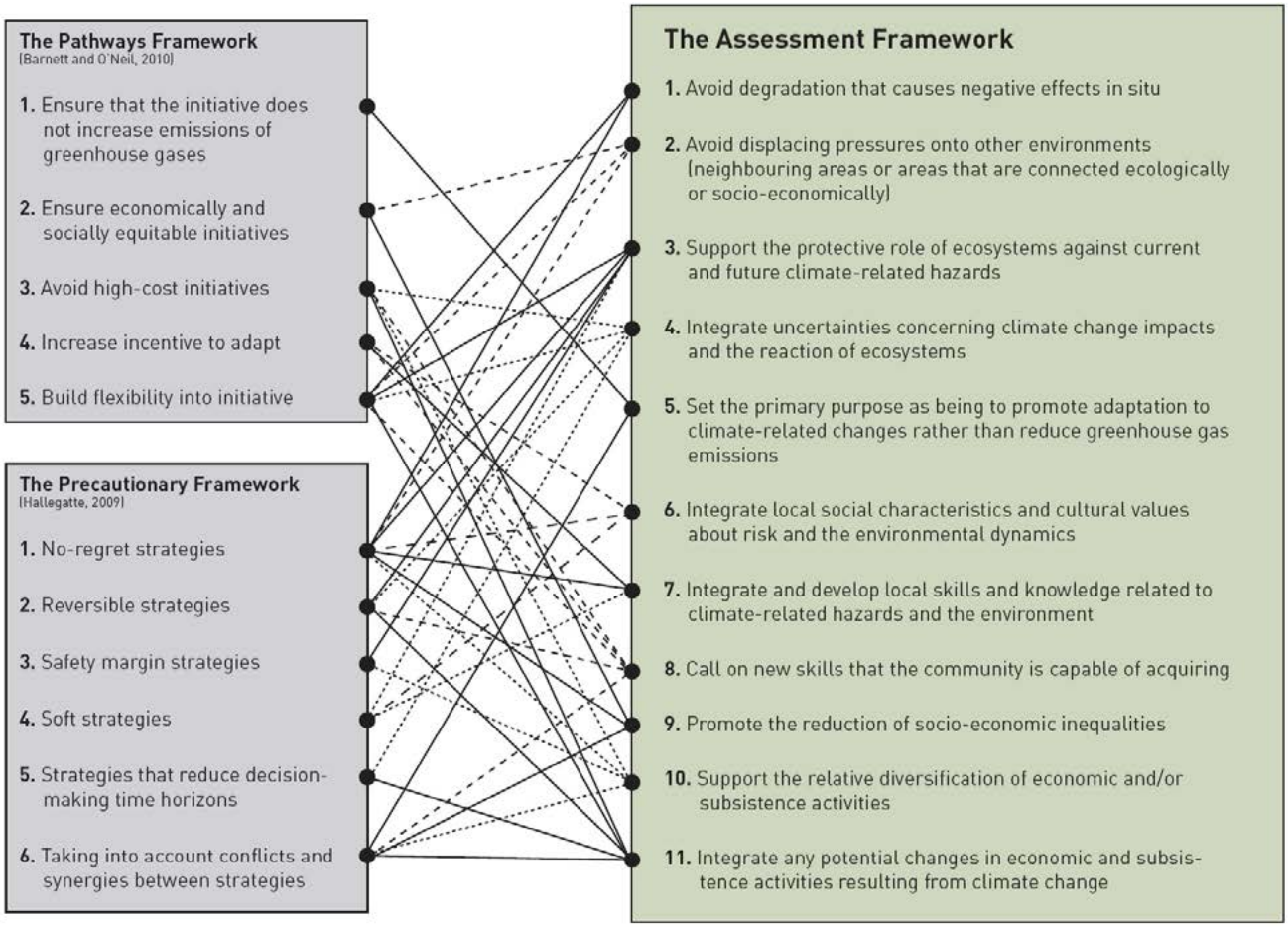

Figure 33. Maladaptation Assessment Framework proposed by Magnan and Mainguy (2014)

Hulhumalé, Maldives: this is an island made of reclaimed land designed to meet the existing and future housing, industrial and commercial development demands of the Malé region, with the aim of housing between a third and a half of the Maldivian population by 2050. But how viable is this approach longer term? While relocation is expected to relieve resource pressures on other parts of the atoll nation, Hulhumalé is just metres above sea level and its creation via extensive dredging has severely damaged surrounding marine ecosystems, including coral reefs.

Afar, Ethiopia: This is an extensive, arid region of north-western Ethiopia where 80% of the population are dependent upon pastoralist livelihoods. Rising temperatures and aridity have severely affected Afar in the past decade. Government policy to date has focused on more sustainable practices in the form of irrigated, sedentary (often commercial) agriculture. As well as being environmentally problematic in terms of sustainability, this has intensified resource and social pressures on the decreasing amounts of land available for pastoralists, thereby increasing levels of poverty and conflict and undermining the ability of groups to adapt to changing conditions.

South-west Bangladesh: According to the authors, this is an example of how "decision-makers can sometimes justify investments in adaptation on the basis of short- to medium-term benefits, with a high benefit to cost ratio. Over time, as the effects of climate change increase, the benefits can decline and the investment may have serious adverse consequences". The multilaterally funded Coastal Climate-Resilient Infrastructure Project in south-west Bangladesh aims to foster climate resilience by upgrading over 500 km of infrastructure and constructing and improving cyclone and animal shelters. However, this region is one of the most vulnerable parts of a country that is highly susceptible to resource degradation through environmental change. The project may "insidiously encourage the resident population to remain in these hazardous areas", reduce or reverse the current trends of outmigration from the region and prove unsustainable in its ability to protect the population from predicated changes in climatic conditions and resource shifts.

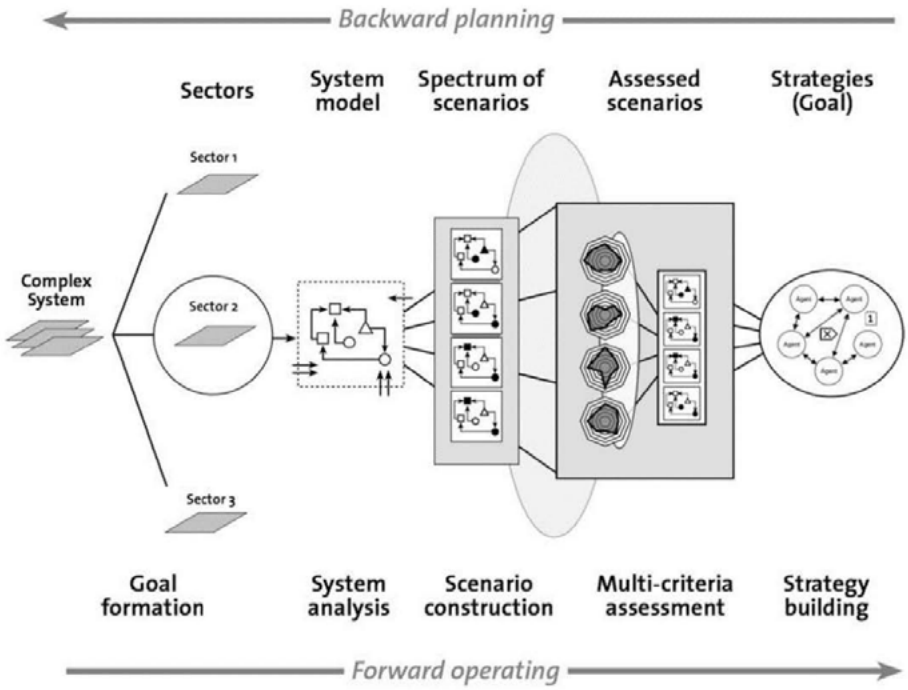

Figure 34. Iterative policy planning for a complex adaptive system (Wiek and Walter 2009)

The frameworks, ideas and examples on maladaptation relate to "when things go wrong" (Schipper 2020) within the systems approach adopted in this report and relevant policymaking caveats. Maladaptation experts emphasize the importance of considering many types of dynamic, highly contextual drivers across time and space.

6.5 Conclusion

The resource-mobility nexus challenges conventional approaches to policymaking because of its inherent properties as a complex adaptive system. The IRP considers resource drivers and impacts of human mobility as part of a connected system of feedback loops. Since migration can be an adaptive strategy for resource constraints and inability to migrate can itself cause greater resource stress, linear models and causal theories for policy impact are elusive. This requires an adaptive planning framework with continuous monitoring of a range of data and thresholds. Policymakers need to be flexible in their decision-making and base their approach on planning frameworks derived from the computational field of operations research. Figure 34 shows how such a policy planning framework can be used. However, it is essential to implement this at the right scale and not be tempted to draw comparisons where the key data parameters are different. The policy planning process is thus inherently iterative. Appendix 1 provides some specific examples of policy actions that could be developed in this regard. The goals can be measured in terms of efficient resource delivery for a specific well-being target. The latter could be measured through quality of life indices. The most ecologically efficient resource consumption patterns informed by policy decisions can then be mapped to those indicators.

If such a systems model suggests resource scarcity within certain scenarios, these could be assessed through a consultative process with community members to formulate contingency plans for voluntary and involuntary mobility. Donors could also gain from such an approach, as noted by Ramalingam (2015) in Aid in the Age of Chaos. While such an iterative approach may be initially unsettling for policymakers, the migration-resource nexus demands such flexibility. The use of free heuristics to guide policy and decision-making has also been proposed in some contexts. This final chapter has attempted provide specific examples of policy tools that could be used in a range of scenarios involving resources and human mobility.

APPENDIX A
EXAMPLES OF POLICY RESPONSES TO MIGRATION

Policy	Impact	Obstacles	Scale	Examples
Microcredit Schemes	• Ability to obtain assets and capabilities needed to become less susceptible to shocks and stresses and/or cope with their impacts	• Repayments can further trap people in place. Limited availability. Often resources do not reach poorest of the poor.	• Usually local	• Self Employed Women's Association (India) • Bangladesh Unemployed Rehabilitation Organisation
Natural hazard related financial support	• Access rapid and predictable financing when disaster strikes for food security and livelihoods	• Usually currently served on an ad hoc basis, meaning delays. Often linked to formalized (exc. informal) economy	• Regional to international	
Insurance Policies	• Expanding the financial resilience of the population to disasters and shocks	• Affordability issues, large transactions costs for small portfolios, weak institutions, lack of trust	• Local to national	• Turkish Catastrophe Insurance Pool (TCIP). Mongolian Livestock Insurance Pool African Risk Capacity
Resettlement and assisted migration schemes	• Allows orderly and managed movement of people away from already affected or vulnerable areas	• Ofthen stringent and arbitrary terms attached to eligibility. Does not reach poorest sections of society. Many may not wish to move	• Local to national	• Viet Nam - GOV and UNFCCC linked planned relocation schemes to support mobility away from risky locations • SIDS - Facilitation of movement to US, NZ through labor schemes and passport and visa support
Remittance schemes that support sustainable resource management "back home"	• Adds to already significant revenues from remittances sent home by diaspora	• Reliance upon external resources may limit indigenous development and cause "brain drain"	• International	• Pakistan - money invested by migrants matches by gov

Policy	Impact	Obstacles	Scale	Examples
Policies to discourage land conversion	• Evaluates propensity of soil to be eroded and other soil qualities • Easy to interpret	• Lack of baseline data in many country contexts	• Local to country scale	• **USA's Land capability classification system** No subsidies provided for land conversions within certain classes where land degradation is likely
Land use planning: Common property approach	• Gives communities agency over resource use decisions	• **Corruption** Local "land grabbing" for onward sale • **Gender** If only men inherit land based on cultural norms.	• Country-specific. Need to identify culturally appropriate policies	• **Bolivia's land reforms** Communities needed to organize and given land tenure. Can then decide locally how to utilize land
Resource inventories	• Discourage migration to areas of resource vulnerability or scarcity	• Lack of baseline data in many country contexts	• Local to country scale	• **USDA's National Resource Inventory** Collects and produces information on the status and trends of land, soil, water, and related resources
Land restoration efforts	• Inform decisions about where to invest in restoration	• Currently largely conceptual • Restoring areas that are likely to be (re)degraded	• Local to regional	• Africa's Green Wall • Pakistan's "Tree Tsunami" • Mexico's Forestry Commission
Water markets	• Compensate users (farmers) for the use of finite water resources	• Sufficiently factoring in "externalities" into market dynamics	• Regional to country	• USA • Australia • Chile • China

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ABOUT THE INTERNATIONAL RESOURCE PANEL

Aim of the Panel

The International Resource Panel was established to provide independent, coherent and authoritative scientific assessments on the use of natural resources and their environmental impacts over the full life cycle. The Panel aims to contribute to a better understanding of how to decouple economic growth from environmental degradation while enhancing well-being.

Benefiting from the broad support of governments and scientific communities, the Panel is constituted of eminent scientists and experts from all parts of the world, bringing their multidisciplinary expertise to address resource management issues.

The information contained in the International Resource Panel's reports is intended to:

- be evidence based and policy relevant,
- inform policy framing and development, and
- support evaluation and monitoring of policy effectiveness.

Outputs of the Panel

Since the International Resource Panel's launch in 2007, more than 33 assessments have been published. The assessments of the Panel to date demonstrate the numerous opportunities for governments, businesses and wider society to work together to create and implement policies that ultimately lead to sustainable resource management, including through better planning, technological innovation and strategic incentives and investments.

Following its establishment, the Panel first devoted much of its research to issues related to the use, stocks and scarcities of individual resources, as well as to the development and application of the perspective of 'decoupling' economic growth from natural resource use and environmental degradation. These reports include resource-specific studies on biofuels, water and the use and recycling of metal stocks in society.

Building upon this knowledge base, the Panel moved into examining systematic approaches to resource use. These include looking into the direct and indirect impacts of trade on natural resource use; issues of sustainable land and food system management; priority economic sectors and materials for sustainable resource management; benefits, risks and trade-offs of low-carbon technologies; city-level decoupling; and the untapped potential for decoupling resource use and related environmental impacts from economic growth.

Upcoming work

In the forthcoming months, the International Resource Panel will focus on status, trends, outlook, and solutions for sustainable resource management, the socioeconomic implications of resource efficiency and the circular economy, the connections between finance and sustainable resource use and circular economy in consumer electronic products, among others.

More information about the Panel and its research can be found at:

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SUMMARY FOR POLICY MAKERS

Human Migration and Natural Resources: Global assessment of an adaptive complex system

Resources such as minerals, land, water and energy are key drivers of human mobility. Policymakers should recognize the complexity of the resource-migration nexus and the need to monitor resource-scarce areas, particularly those with vulnerable human populations. Current crises in Ukraine, Venezuela (Bolivarian Republic of), Afghanistan, amongst others have led to a focus on forced displacement. While such tragic episodes can have a resource nexus as well, they are part of a much wider range of human mobility phenomena that impacts human development. The availability or scarcity of natural resources impacts patterns of migration. Resource abundance can attract immigration; resource scarcity can either "trap" populations or lead to emigration (where that is possible).

This report opens a discussion about the natural resource nexus with human mobility, using an integrative approach that considers multiple causalities and networks of interaction. This report finds that natural resources have a significant impact on human mobility, but that the relationships are not linear. Based on scientific findings, the report advocates for a complex adaptive systems approach to policy interventions. These should consider sociopsychological, financial and demographic factors that mediate natural resource-(im)mobility pathways. The report further identifies efficient policies within the resource-mobility nexus such as: land ownership and tenure rights and migrant remittances (including "green remittance bonds") as a way to manage the resource-mobility nexus more effectively for better ecological and socio-economic outcomes.

UN environment programme

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