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Migration, environment and climate change: Literature review

First report in the "Migration, environment and climate change" series

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Migration, environment and climate change: Literature review

First report in the "Migration, environment and climate change" series

by

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Abstract: Migration, Environment and Climate Change: Literature Review

This literature review provides an overview of theoretical and empirical research into the linkages between environmental stressors – including climate change – and human mobility. Migration in response to changes in the environment is not new, indeed it is part of the story of human inhabitation of our planet. Early theorists of migration considered the environment as a causal factor in the late nineteenth century, but research efforts to better understand the complexities of this linkage are much more recent (the first publications date back to the 1980s). However, increased understanding of the likely impacts of climate change from the 1990s – fueled by alarmist predictions about the possible impacts on human migration - has led to a surge in research into the environment-migration nexus since the 2000s.

This review takes stock of this evolution, by providing a structured analysis of key findings, including an overview of the diverse methodological challenges facing researchers. It begins by retracing the evolution of research on environment-migration linkages, situating research within its wider political context. It has become increasingly clear from this research that migration related to environmental factors is multi-causal, and that a range of other factors need to be taken into account, including at the "micro" level of individual and household decisions. Environmental stressors do not necessarily lead to migration, and indeed there is a growing realisation that some of the people most vulnerable to environmental changes will be those who are unable to move.

Nonetheless, changes to our environment, caused by changing patterns of sudden-onset events or increasing temperatures, are likely to become increasingly important causal factors of migration globally in years ahead. One of the key challenges for researchers will be to improve understanding of how environmental migration relates to vulnerability - which factors determine whether mobility contributes positively or negatively to the livelihoods of people affected by environmental and climatic changes - in order to provide scientific and evidence-based policy advice and to inform appropriate policy interventions.

Kurzbeschreibung: Migration, Umwelt und Klimawandel: Literaturrecherche

Diese Literaturstudie gibt einen Überblick über die theoretische und empirische Fachliteratur zu den Zusammenhängen zwischen Umweltstressoren - einschließlich Klimawandel - und menschlicher Mobilität. Migration als Reaktion auf Umweltveränderungen ist nicht neu, sondern Teil der Geschichte der menschlichen Besiedlung unseres Planeten. In den Migrationstheorien des späten 19. Jahrhundert wurde Umwelt als ein Kausalfaktor für Migration gesehen. Die Forschungsbemühungen zum besseren Verständnis der Komplexität dieser Verbindung sind aber viel aktueller (die ersten Veröffentlichungen stammen aus den 1980er Jahren). Ein besseres Verständnis der wahrscheinlichen Auswirkungen des Klimawandels stammt jedoch aus den 1990er Jahren und wurde durch alarmierende Vorhersagen über die möglichen Auswirkungen auf die menschliche Migration angeheizt. Das führte dazu, dass seit den 2000er Jahren eine Zunahme der Forschung über den Zusammenhang zwischen Umweltveränderungen und Migration zu verzeichnen ist.

Die Studie zieht Bilanz über diese Entwicklungen in der Literatur, indem sie eine strukturierte Analyse der wichtigsten Ergebnisse liefert, einschließlich eines Überblicks über die verschiedenen methodischen Herausforderungen, vor denen die Forschung steht. Zuerst wird die Entwicklung der Forschung zu den Zusammenhängen zwischen Umwelt und Migration dargestellt und die Forschung in ihren breiteren politischen Kontext gestellt. Aus dieser Forschung geht immer deutlicher hervor, dass Migration im Zusammenhang mit Umweltfaktoren multikausal ist und dass eine Reihe anderer Faktoren berücksichtigt werden müssen, auch auf der Mikroebene, also individuelle und Haushaltsentscheidungen. Umweltstressoren führen nicht unbedingt zu Migration, und nach und nach wächst die Einsicht, dass

einige der Menschen, die am anfälligsten für Umweltveränderungen sind, diejenigen sein werden, die nicht in der Lage sind, ihre Heimat zu verlassen.

Dennoch kann davon ausgegangen werden, dass Veränderungen in der Umwelt und daraus resultierende veränderte Muster von plötzlich auftretenden Ereignissen oder steigende Temperaturen, in den nächsten Jahren weltweit zu immer wichtigeren Kausalfaktoren der Migration werden. Eine der zentralen Herausforderungen der Forschung wird darin bestehen, das Verständnis darüber, wie Umweltmigration mit Vulnerabilität zusammenhängen, zu verbessern und herauszuarbeiten, welche Faktoren maßgeblich dafür sind, ob Mobilität positiv oder negativ zur Existenzgrundlage der von Umwelt- und Klimaveränderungen betroffenen Menschen beiträgt. Neugewonnene Erkenntnisse sollen wissenschaftliche und evidenzbasierte Politikberatung ermöglichen und Entscheidungsträgerinnen und Entscheidungsträger zu geeigneten politischen Maßnahmen befähigen.

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List of abbreviations

ABM	Agent Based Modelling
BMU	Federal Ministry for the Environment, Nature Conservation and Nuclear Safety
CDR	Call Data Record
DFID	Department for International Development (United Kingdom)
DRR	Disaster Risk Reduction
EM-DAT	Emergency Events Database
IASC	Inter-Agency Standing Committee
IDMC	Internal Displacement Monitoring Centre
IDP	Internally Displaced Person
IOM	International Organization for Migration
IPCC	Intergovernmental Panel on Climate Change
MECLEP	"Migration, Environment and Climate Change: Evidence for Policy" project
NELM	New Economics of Labour Migration
NGO	Non-Governmental Organisation
PRA	Participatory Rural Appraisal
UAV	Unmanned Aerial Vehicle
UBA	German Environment Agency
UNDP	United Nations Development Programme
UNFCCC	UN Framework Convention on Climate Change
UNISDR	UN Office for Disaster Risk Reduction

Summary

The first paper produced for this research project sought to answer the question: what knowledge, evidence and data are currently available to inform policymaking related to migration, displacement and planned relocation in the context of environmental and climate change? To this end, it provides a comprehensive literature review of academic journal articles, government reports, and publications by German and international agencies and institutions working in relevant areas.

To prepare the literature review, the authors reviewed and evaluated the literature in successive stages. As a first step, a wide range of papers was examined, taking into account the relevance, the scale, the date of publication and the language of the studies. The author then selected a list of studies and publications for more in-depth evaluation on the basis of the following criteria: number of citations, innovative content, quality of methodology and replicability and generalizability of results. The author assessed important findings from this initial review in a structured evaluation matrix, providing information on the sources for each key finding, evaluating their reliability, and briefly outlining potential policy implications.

This evaluation served as the basis for the literature review, which provides the reader with insights into important debates that have shaped research and policy on the nexus between migration, environment and climate change over the past decades. They show how the history and politics of research in the field have been intertwined since the 1980s, and outline key considerations with regard to terminology, theoretical approaches, data challenges, and methodology. Finally, the review summarises the main findings from the literature in seven areas to make them accessible for a wider audience.

Key findings

1. Data and prognoses

The literature review shows that the various studies that have attempted to make quantified predictions about the future scale of environmental migration have been widely criticized due to methodological flaws. The majority of these prognoses look at migration relating to slow-onset environmental stressors. However, distinguishing the role of slow-onset environmental phenomena in future migration is subject to multiple uncertainties, given the multiple factors at play in decisions to migrate and in long-term development processes. For this reason, the Foresight study (2011) by the UK Government Office for Science explicitly abstained from making any quantified predictions, instead presenting a range of striking data for the numbers of people at risk from various environmental change-related stressors. For example, it estimated that population levels in Low Elevation Coastal Zones (i.e. “at risk”) are set to increase dramatically across varying scenarios in the future, due to a combination of natural population growth and rural-urban migration. Further, a 2018 study by the World Bank, “Groundswell – Preparing for internal climate migration” found that without ambition cuts in greenhouse gas emissions and “robust development action” in the regions of Sub-Saharan Africa, South Asia, and Latin America climate change could by 2050 force more than 143 million people to move within their countries to escape slow-onset climate change impacts.

Regarding displacement caused by sudden-onset disasters, the literature review highlighted the data and a modelling of disaster displacement within countries compiled by the Internal Displacement Monitoring Centre (IDMC). This points to a clear upward trend in the number of people who are at risk of being displaced within countries by sudden-onset hazards in the future, with explanatory factors including population growth (increased exposure), improvements in disaster preparedness (more people survive disasters, but therefore more are displaced), and improved reporting of disaster impacts since the 1980s (Ginnetti, 2015). Since 2008, IDMC has produced annual estimates for the number of people displaced within their country by sudden-onset events. Although certain caveats must still be born in mind with these figures, IDMC (2019) found that natural disasters have generated 265.3 million “new displacements” within countries between 2008 and 2018, with floods, storms and earthquakes constituting the principal sources.

2. Internal and international migration

With regard to how far people migrate, the reviewed literature shows that migration usually occurs within countries and often takes place locally. This can mostly be attributed to the high costs for international migration, immigration restrictions in potential destination countries, and the greater ease with which they can find work and accommodation. There is also evidence that some people may move in a "stepping stones"- pattern, from smaller, nearby towns to larger, more distant cities, as show in the Where the Rain Falls research study (Warner et al, 2012). When people migrate internationally, they usually do so across borders to neighbouring countries, rather than overseas.

In general, the literature review finds that many studies provide evidence that gradual environmental change (average temperature, rainfall, rainfall variability) is one of the factors driving internal migration. Seasonal migration out of rural areas during the "dry season" or the "flood season" has also been widely documented, not necessarily linked to broader environmental change.

Concerning movements linked to sudden-onset events, the literature review found that they are often complex, multi-stage processes and shaped by a range of micro, meso and macro-level factors. People may flee to the nearest save place immediately after an event to ensure survival. Many people move a few kilometres to camps or to stay with friends and relatives in the surrounding area (they are hardly ever captured in official statistics). Subsequently people may move further afield to find work. Some may then settle permanently at the new site and others may settle far away. When looking at droughts, it was found that movements vary greatly, depending in part on the severity of the drought.

3. Temporary and permanent migration

Migration can be both temporary and permanent. Temporary (often seasonal) migration has been widely documented in response to environmental stressors, and increasingly understood as an integral part of livelihood and/or food security strategies. The fairly recent concept of 'circular migration' has been increasingly applied to studies of environmental migration. It posits that many migration 'trajectories' are composed of a series of movements between origin and destination areas (sometimes over long periods/decades). Migrants develop and maintain strong ties to both, and often bring positive developmental contributions to origin areas beyond remittances. This can include support for climate change/environmental change adaptation.

The review paper shows that disaster-induced displacement is often temporary, and people seek to return. However, when disasters leave lasting damage, there is a higher chance that displaced people may decide to permanently migrate or that the government may plan to relocate exposed communities to safety.

Permanent relocation of whole communities by public authorities is widely expected to become increasingly necessary as environmental change processes take hold. While in most cases planned relocation of this kind will be internal, international relocation may become the only option for a number of low-lying island states, in the face of sea-level rise. Further, there is also a significant risk that climate change mitigation and adaptation policies could result in the need for planned relocation within countries.

4. Forced and voluntary movements

Furthermore, migration can be forced or voluntary. However, the distinction between forced and voluntary movements is blurred in many cases. For example, when it comes to the decision to send a household member elsewhere for work after a disaster. This seems to be a voluntary decision, but the circumstances can force households to take this decision to maintain income during this period. Similarly, in the case of autonomous permanent out-migration, some people may move away pre-emptively, before their livelihoods are destroyed, but the question remains whether pre-emptive movement can be classified as "forced".

5. Vulnerability and resilience

Reviewing the literature on human mobility as a response to environmental stressors, it was found that multiple studies show that migration can be a successful strategy for adapting to climate change, diversifying sources of income or managing risk, and should not be regarded as a negative outcome of environmental change per se. A possible positive impact of migration can be the reduction of overall exposure to risk of rural households due to family members who undertake seasonal work elsewhere. Diaspora communities also make significant contributions in support of adaptation to environmental change in their origin communities. Remittances are often the first financial support that arrives in the immediate aftermath of disasters, for example.

However, it should also be recognised that migration is not generally the preferred option, and that migration as a response to environmental stressors can also have negative dimensions. For example, with regard to the classic example of remittance-sending by a household member, the vulnerable conditions in which many such migrants find themselves at destination, or the additional strain imposed on those who stay behind ("brain drain", "lost labour"), are often not considered. The Foresight study (2011) also brought the issue of "trapped" or "immobile" populations to the fore, emphasising the distinction between those who are unable to migrate (involuntarily immobile, or "trapped populations") and those who choose not to move (voluntarily immobile). Reasons that hinder people to move are for example that they lack financial resources, network or knowledge and skills to do so. Furthermore, assets and family responsibilities, but also a lack of understanding of the situation are reasons to stay. Sometimes, moving is not considered as an option for example due to cultural attachments.

6. Conflict linkages

There has been a high level of interest among policymakers on the linkages between climate change, migration and conflict, but the evidence paints a mixed picture. For example, the analyses of Thomas Homer-Dixon (1994; 1999) show causal links between environmental factors, migration and conflict. It was found that in areas with resource scarcity, out-migration can lead to tensions and conflict in receiving communities. However, the potential for conflict is determined by a range of contextual factors, and in-migration by itself is rarely found to be a direct cause of conflict. Every conflict is the result of complex interactions between different social, political, economic, demographic and environmental factors and, thus, climate change has been increasingly understood as a "threat multiplier" rather than a direct cause of conflict. Out-migration from environmentally degraded areas taking place over long timescales means less potential for major tensions, while the potential for conflict increases when large numbers of people migrate over short time frames to communities ill-equipped to absorb them. There remains a lack of evidence regarding conflict potential resulting from large-scale disaster-induced displacement. However, some studies have pointed to increasing potential for conflict when large influxes of refugees come to camps and compete with local communities over access to natural resources.

7. Environmental migration to Europe

There is very little reliable evidence for existing environmental migration to Europe, primarily due to the lack of appropriate data and the complexity of distinguishing environmental drivers among and from other drivers. However, to dismiss the topic's relevance for Europe in view of the uncertainties relating to environmental migration to Europe, would be to fail to acknowledge the increasing threats posed by environmental change processes within Europe itself, and the potential for future migration and displacement. There are multiple examples of displacement due to environmental changes within Europe. For example, in 2012, 13,000 people were displaced by wildfires in Spain (Ionesco et al, 2017: 45). IDMC showed that in 2017 natural hazards had displaced approximately 66,000 people in Europe. Furthermore, some European countries, like the Netherlands and Germany, will also have to address challenges relating to sea-level rise.

Zusammenfassung

Die erste Teilstudie, die für dieses Forschungsprojekt erstellt wurde, zielte auf die Beantwortung der Frage ab: Welches Wissen, welche Erkenntnisse und Daten stehen derzeit zur Verfügung, um die Politik im Nexus von Migration, Vertreibung und geplanten Umsiedlungen im Kontext des Umwelt- und Klimawandels zu beraten? Zu diesem Zweck bietet es eine umfassende Literaturrecherche basierend auf wissenschaftlichen Zeitschriftenartikeln, Regierungsberichte und Veröffentlichungen deutscher und internationaler Einrichtungen und Institutionen, die im jeweiligen Bereich tätig sind.

Zur Vorbereitung der Literaturrecherche haben die Verfasserinnen und Verfasser die Literatur in mehreren Schritten gesichtet und bewertet. In einem ersten Schritt wurde eine Vielzahl von Arbeiten untersucht, wobei die Relevanz, der Umfang, das Erscheinungsdatum und die Sprache der Studien berücksichtigt wurden. Der Verfasser wählte dann eine Liste von Studien und Publikationen für eine eingehendere Bewertung anhand folgender Kriterien aus: Anzahl der Zitate, innovativer Inhalt, Qualität der Methodologie und Replizierbarkeit sowie Generalisierbarkeit der Ergebnisse. Der Verfasser beurteilte wichtige Ergebnisse dieser ersten Überprüfung in einer strukturierten Bewertungsmatrix, indem er Informationen über die Quellen für alle wichtigen Ergebnisse bereitstellt, ihre Zuverlässigkeit bewertet und mögliche politische Konsequenzen kurz skizziert.

Diese Analyse diente als Ausgangspunkt für die Literaturrecherche, der den Leserinnen und Lesern Einblicke in wichtige Debatten gewährt, die Forschung und Politik über den Nexus von Migration, Umwelt und Klimawandel in den letzten Jahrzehnten geprägt haben. Sie zeigen, wie Geschichte und Politik der Forschung in diesem Themenbereich seit den 1980er Jahren miteinander verflochten sind, und skizzieren wichtige Überlegungen in Bezug auf Terminologie, theoretische Ansätze, datentechnische Herausforderungen und Methodologien. Schließlich fasst der Überblick die wichtigsten Erkenntnisse aus der Literatur in sieben Themenfeldern zusammen, um sie einem breiteren Publikum zugänglich zu machen.

Wichtige Ergebnisse

1. Faktenlage und Prognosen

Die Literaturrecherche zeigt, dass die verschiedenen Studien, aus denen quantifizierbare Vorhersagen über das zukünftige Ausmaß der Umweltmigration gemacht wurden, aufgrund ihrer methodologischen Mängel stark kritisiert worden sind. Die Mehrheit dieser Prognosen betrachtet die Migration im Zusammenhang mit schleichend einsetzenden Umweltstressfaktoren. Die Differenzierung der Rolle von graduell einsetzenden Umweltphänomenen bei zukünftiger Migration ist jedoch mit mehreren Unsicherheiten behaftet, da viele Faktoren bei Migrationsentscheidungen und in langfristigen Entwicklungsprozessen eine Rolle spielen. Aus diesem Grund verzichtete die Foresight-Studie (2011) des britischen Wissenschaftsministeriums ausdrücklich auf quantifizierbare Prognosen und präsentierte stattdessen eine Reihe von aussagekräftigen Fakten über die Anzahl der von unterschiedlichen Umweltstressfaktoren gefährdeten Personen. So hat die Studie beispielsweise geschätzt, dass die Bevölkerungszahl in den niedrig gelegenen Küstenzonen (d.h. „bedroht") in den verschiedenen Zukunftsszenarien aufgrund einer Kombination aus natürlichem Bevölkerungswachstum und Land-Stadt-Migration drastisch zunimmt. Darüber hinaus ergab eine Studie der Weltbank aus dem Jahr 2018, „Groundswell - Preparing for internal climate migration (Zunahme – Vorbereitung auf interne Klimamigration)", dass, ohne ambitionierte Einschnitte bei den Treibhausgasemissionen und „robuste Entwicklungsmaßnahmen" in den Regionen Subsahara-Afrikas, Südasiens und Lateinamerikas, der Klimawandel bis 2050 mehr als 143 Millionen Menschen zwingen könnte, innerhalb ihrer Heimatländer zu migrieren, um den langsam einsetzenden Auswirkungen des Klimawandels zu entfliehen.

Hinsichtlich der Vertreibung durch plötzlich auftretende Katastrophen hat die Literaturrecherche die vom Internal Displacement Monitoring Centre (IDMC) erstellten Daten und ein Modell der Vertreibung bei

Katastrophen innerhalb von Ländern beleuchtet. Dieses deutet auf einen deutlichen Anstieg der Zahl der Menschen hin, die in Zukunft Gefahr laufen, durch plötzlich auftretende Gefährdungen innerhalb ihrer Heimatländer vertrieben zu werden, was unter anderem auf das Bevölkerungswachstum (erhöhte Exponiertheit), die Verbesserung der Katastrophenvorsorge (mehr Menschen überleben Katastrophen, aber es werden mehr vertrieben) und eine verbesserte Berichterstattung über die Auswirkungen von Katastrophen seit den 80er Jahren (Ginnetti, 2015) zurückzuführen ist. Seit 2008 erstellt IDMC jährliche Schätzungen über die Zahl der in ihrem Land durch plötzlich auftretende Ereignisse vertriebenen Menschen. Obwohl bei diesen Zahlen noch gewisse Einschränkungen zu beachten sind, stellte die IDMC (2019) fest, dass Naturkatastrophen zwischen 2008 und 2018 265,3 Millionen „neue Vertreibungen" innerhalb von Ländern verursacht haben, wobei Überschwemmungen, Stürme und Erdbeben die Hauptursachen darstellen.

2. Binnenmigration und internationale Migration

Im Hinblick darauf, wie weit Menschen migrieren, zeigt die eingesehene Literatur, dass Migration in der Regel innerhalb von Ländern und oft auf lokaler Ebene stattfindet. Dies ist im Wesentlichen auf die hohen Kosten für die internationale Migration, Einwanderungsbeschränkungen in potenziellen Zielländern und die erleichterte Suche nach Arbeit und Unterkunft zurückzuführen. Es gibt auch Anzeichen dafür, dass sich einige Menschen in einem „Sprungbrett"-Muster bewegen und zwar von kleineren, nahe gelegenen Städten in größere, weiter entfernte Städte, wie die Ergebnisse der Studie Where the Rain Falls (Wo der Regen fällt) zeigen (Warner et al, 2012). Wenn Menschen international migrieren, dann meistens in Nachbarländer und nicht ins ferne Ausland.

Die Literaturübersicht stellt im Allgemeinen fest, dass zahlreiche Studien den Beweis erbringen, dass langsame Umweltveränderungen (Durchschnittstemperatur, Niederschlag, Niederschlagsvariabilität) einer der treibenden Faktoren der Binnenmigration sind. Die saisonale Migration aus ländlichen Gebieten während der „Trockenzeit" oder der „Hochwassersaison" ist ebenfalls umfassend dokumentiert und nicht unbedingt einer tiefgreifenden Umweltveränderung geschuldet.

Hinsichtlich der Migrationsbewegungen im Zusammenhang mit plötzlich auftretenden Ereignissen stellte die Literaturrecherche fest, dass es sich oft um komplexe, mehrstufige Prozesse handelt, die von einer Reihe von Faktoren auf Mikro-, Meso- und Makroebene bestimmt werden. Menschen fliehen unmittelbar nach einem Ereignis an den nächsten sicheren Ort, um ihr Leben zu retten. Viele Menschen ziehen in ein einige Kilometer entferntes Lager oder zu Freunden und Verwandten in der Umgebung (diese werden nur selten in der offiziellen Statistik erfasst). In der Folge kann es vorkommen, dass Menschen weiter wegziehen, um Arbeit zu finden. Einige werden sich in der Folge dauerhaft am neuen Standort ansiedeln und wieder andere in einer entfernteren Gegend. Bei Dürren zeigte sich, dass die Bewegungen stark variieren, was teilweise von der Schwere der Dürre abhängig ist.

3. Temporäre und permanente Migration

Migration kann sowohl temporär als auch dauerhaft sein. Temporäre (oft saisonale) Migration wurde als Reaktion auf Umweltstressfaktoren umfassend dokumentiert und zunehmend als integraler Bestandteil von Strategien zur Sicherung der Lebensgrundlage und/oder der Ernährungssicherheit aufgefasst. Das relativ neue Konzept der „zirkulären Migration" wurde zunehmend auf Studien zur Umweltmigration angewendet. Darin wird die Annahme vertreten, dass viele Migrationsbewegungen aus einer Abfolge von Bewegungen zwischen Herkunfts- und Zielgebiet bestehen (manchmal über lange Zeiträume/Jahrzehnte). Migrantinnen und Migranten entwickeln und pflegen starke Beziehungen zu beiden Gebieten und leisten oft einen, nicht nur in Form von Geldtransfers, positiven Beitrag zur Entwicklung der Herkunftsgebiete. Dazu kann auch die Unterstützung bei der Anpassung an den Klimawandel und an Umweltveränderungen gehören.Das Recherchepapier zeigt, dass katastrophenbedingte Vertreibung oft nur vorübergehend ist und Menschen versuchen, zurückzukehren. Wenn Katastrophen jedoch dauerhafte Schäden verursachen, besteht eine höhere Wahrscheinlichkeit, dass Vertriebene sich für eine dauerhafte Abwanderung

entscheiden oder dass sich die Regierung dafür entscheidet, gefährdete Gemeinden in sichereren Gebieten anzusiedeln.

Angesichts der zunehmenden Umweltveränderungen wird davon ausgegangen, dass eine dauerhafte Umsiedlung ganzer Gemeinden seitens der Behörden immer dringlicher wird. Während es sich in den meisten Fällen um innerstaatliche Umsiedlungen handelt, könnte die internationale geplante Umsiedlung aufgrund des Anstiegs des Meeresspiegels für eine Reihe von niedrig gelegenen Inselstaaten als einzige Option in Frage kommen. Darüber hinaus besteht auch ein erhebliches Risiko, dass aufgrund der Klimaschutz- und Anpassungsmaßnahmen planmäßige Umsiedlung innerhalb der Länder erforderlich wird.

4. Erzwungene und freiwillige Migration

Darüber hinaus kann Migration erzwungen oder freiwillig sein. Die Unterscheidung zwischen erzwungenen und freiwilligen Bewegungen ist jedoch in vielen Fällen unscharf. So zum Beispiel wenn es um die Entscheidung geht, ein Mitglied eines Haushalts nach einer Katastrophe zur Arbeit an einen anderen Ort zu schicken. Diese Entscheidung scheint freiwillig zu sein, jedoch kann es aufgrund der Umstände vorkommen, dass die Haushalte diese Entscheidung zur Sicherung ihres Einkommens während dieses Zeitraums zwangsläufig treffen müssen. Ebenso können im Falle einer eigenständigen dauerhaften Abwanderung einige Menschen vorzeitig wegziehen, noch bevor ihre Lebensgrundlagen zerstört sind. Indessen bleibt zu klären, ob die präventive Abwanderung als „erzwungen" einzuordnen ist.

5. Vulnerabilität und Widerstandsfähigkeit

Bei der Beurteilung der Literatur über menschliche Mobilität als Reaktion auf Umweltstressfaktoren zeigte sich, dass zahlreiche Studien belegen, dass Migration eine erfolgreiche Strategie zur Anpassung an den Klimawandel, zur Erschließung alternativer Einkommensmöglichkeiten oder zum Risikomanagement sein kann und nicht als negatives Resultat von Umweltveränderungen per se angesehen werden sollte. Ein möglicher positiver Effekt der Migration kann die Verringerung der Gesamtbelastung von Haushalten in ländlichen Gebieten aufgrund von Familienangehörigen sein, die andernorts Saisonarbeit verrichten. Diasporagemeinschaften leisten zudem wichtige Unterstützung bei der Anpassung an Umweltveränderungen in den Herkunftsregionen. Geldtransfers sind oft die erste finanzielle Hilfe, die z. B. unmittelbar nach Katastrophen eintrifft.

Allerdings sollte auch berücksichtigt werden, dass Migration im Allgemeinen nicht die vorrangige Lösung ist und dass Migration als Reaktion auf Umweltstressfaktoren auch negative Auswirkungen haben kann. Im Hinblick auf das klassische Beispiel der Geldtransfers durch ein Familienmitglied werden beispielsweise die prekären Bedingungen, unter denen sich viele dieser Migranten im Zielland wiederfinden, oder die zusätzlichen Belastungen für diejenigen, die zurückbleiben („Fachkräfteabwanderung", „verlorene Arbeitskräfte"), oftmals nicht berücksichtigt. Die Foresight-Studie (2011) rückte auch die Frage der „festsitzenden“ oder „immobilen“ Bevölkerungsgruppen in den Vordergrund und betonte die Unterscheidung zwischen denen, die nicht migrieren können (unfreiwillig immobile Bevölkerungsgruppen, oder „Festsitzende“) und denen, die nicht gewillt sind umzusiedeln (freiwillig immobil). Migrationshindernisse sind z.B. der Mangel an finanziellen Mitteln, Netzwerken oder Wissen und Fähigkeiten. Zudem sind Vermögenswerte, familiäre Verpflichtungen, aber auch ein mangelndes Verständnis der Situation Gründe zum Bleiben. Mitunter wird Migration nicht als Option betrachtet, z.B. aufgrund kultureller Bindungen.

6. Konfliktzusammenhänge

Die politischen Entscheidungsträgerinnen und Entscheidungsträger zeigen ein großes Interesse am Nexus von Klimawandel, Migration und Konflikt, allerdings ergeben die Fakten ein gemischtes Bild. So zeigen beispielsweise die Analysen von Thomas Homer-Dixon (1994; 1999) kausale Zusammenhänge zwischen Umweltfaktoren, Migration und Konflikt. Wie sich herausstellte, kann die Einwanderung in Regionen mit

Ressourcenknappheit zu Spannungen und Konflikten in den Zielregionenführen. Das Konfliktpotenzial wird jedoch durch eine Reihe von Faktoren bestimmt, und Zuwanderung an sich ist selten eine der unmittelbaren Ursachen von Konflikten. Jeder Konflikt ist das Ergebnis komplexer Wechselwirkungen zwischen verschiedenen sozialen, politischen, wirtschaftlichen, demographischen und ökologischen Faktoren, so dass der Klimawandel zunehmend als "Bedrohungsmultiplikator" und nicht als direkte Ursache von Konflikten verstanden wird. Abwanderung aus ökologisch geschädigten Gebieten, die über einen langen Zeitraum stattfindet, bedeutet weniger Potenzial für große Spannungen, während das Konfliktpotenzial zunimmt, wenn eine große Zahl von Menschen über einen kurzen Zeitraum in Gegenden abwandert, die unzureichend in der Lage sind, sie aufzunehmen. Es mangelt an Erkenntnissen über das Konfliktpotenzial, das sich aus einer massiven katastrophenbedingten Vertreibung ergibt. Einige Studien haben jedoch auf ein zunehmendes Konfliktpotenzial hingewiesen, wenn große Flüchtlingsströme in Lager kommen und mit örtlichen Gemeinden um den Zugang zu natürlichen Ressourcen konkurrieren.

7. Umweltmigration nach Europa

Es gibt nur sehr wenige zuverlässige Belege für eine bestehende Umweltmigration nach Europa, was vor allem auf das Fehlen geeigneter Daten und die Komplexität der Abgrenzung zwischen Umweltfaktoren und Umwelt von anderen Faktoren zurückzuführen ist. Die Relevanz des Themas für Europa im Hinblick auf die Unsicherheiten im Zusammenhang mit der Umweltmigration nach Europa abzutun, würde jedoch bedeuten, die zunehmende Bedrohung durch ökologische Veränderungsprozesse innerhalb Europas selbst und das Potenzial für zukünftige Migration und Vertreibung nicht zu erkennen. Es gibt zahlreiche Beispiele für Vertreibungen aufgrund von Umweltveränderungen in Europa. Beispielsweise wurden 2012 in Spanien 13.000 Menschen durch Waldbrände vertrieben (Ionesco et al., 2017:45). Das IDMC zeigte, dass im Jahr 2017 durch Naturgefahren rund 66.000 Menschen in Europa vertrieben wurden. Darüber hinaus müssen einige europäische Länder wie die Niederlande und Deutschland auch die Herausforderungen im Zusammenhang mit dem Meeresspiegelanstieg angehen.

Background

This review of literature on the topic of environmental migration[1] comes amid an exponential growth in the number of studies exploring the environment-migration nexus and seeks to provide an up-to-date overview of key findings. Spurred by the burgeoning body of evidence on climate change and its current and predicted impacts across all global regions, the study of environmental migration – as the '"human face of climate change" - has metamorphosed, bringing together scholars from diverse disciplines, and incorporating an array of research methods which become ever more diverse and sophisticated as each year passes. The number of studies has increased rapidly since the first studies were published in the 1980s with almost 100 per year on average since 2008 (Ionesco et al, 2017). This review therefore seeks to take stock of this rapid development.

This review is the first of three papers prepared by the International Organization for Migration (IOM) and Adelphi for the German Environment Ministry (BMU) and German Environment Agency (UBA) within the framework of the project "Environmental degradation, climate change and migration: Synopsis of the review and forecasts on migration and flight induced by environmental degradation and climate change". Drawing on the literature review, the second paper, entitled "Impact Analysis" focuses on some of the keyways in which selected environmental stressors shape human mobility, but also delves further into consideration of how other factors (political, economic, and demographic for instance) come into play. Drawing on these two papers, and a review of existing policy and programmatic initiatives relating to environmental migration, the third paper focuses on policy implications and recommendations.

Table 1: Key terms[2]

Term	Definition
Migration	"The movement of a person or a group of persons, either across an international border, or within a State. It is a population movement, encompassing any kind of movement of people, whatever its length, composition and causes; it includes migration of refugees, displaced persons, economic migrants, and persons moving for other purposes, including family reunification." (IOM, 2011)
Displacement	"A forced removal of a person from his or her home or country, often due to armed conflict or natural disasters." (IOM, 2011:29).
Evacuation	"Evacuation is the rapid movement of people away from the immediate threat or impact of a disaster to a safer place of shelter. It is commonly characterized by a short time frame, from hours to weeks, within which emergency procedures need to be enacted in order to save lives and minimize exposure to harm." (IOM, 2011)
(Planned) Relocation	Permanent voluntary migration, with an emphasis on re-building livelihoods in another place (IOM, 2014d). The World Bank defines relocation as 'a process whereby a community's housing, assets, and public infrastructure are rebuilt in another location.' (World Bank, 2010) Others have emphasized other dimensions in defining relocation as the 'permanent (or long-term) movement of a community (or a significant part of it) from one location to another, in which important characteristics of the original community, including its social structures, legal and political systems, cultural characteristics and worldviews are

[1] This review uses IOM's deliberately broad definition, provided in the table below and discussed further in section 4, which addresses the ongoing debates about terminology in this field of study.

[2] For a more detailed and exhaustive glossary, see IOM (2014d) Glossary - Migration, Environment and Climate Change: Evidence for Policy (MECLEP).

	retained: the community stays together at the destination in a social form that is similar to the community of origin.' (Campbell, 2010)
Human mobility in the context of climate change and environmental change	The term 'human mobility' traditionally refers to the ability (capacity and freedom) to move: "Human mobility [:] The ability of individuals, families or groups of people to choose their place of residence." (UNDP, Human Development Report 2009, p. 15.) The term is increasingly also used in relation to environmental and climate change as an umbrella term to describe the full range of movement types (voluntary migration, displacement, planned relocation). "Population mobility [in the context of environmental change] is probably best viewed as being arranged along a continuum ranging from totally voluntary migration […] to totally forced migration" (Hugo, 1996:107).
Environmental migration	"Environmental migrants are persons or groups of persons who, for compelling reasons of sudden or progressive changes in the environment that adversely affect their lives or living conditions, are obliged to leave their homes or choose to do so, either temporarily or permanently, and who move either within their country or abroad." (IOM, 2007)
Trapped populations	"Populations who 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." This applies in particular to poorer households who may not have the resources to move and whose livelihoods are affected by environmental change. (Foresight, 2011)
Environmental change	"comprises changes in the physical and biogeochemical (chemical, geological, and biological) environment, over a large scale, either caused naturally or influenced by human activities" (Foresight, 2011).
Climate change	"The change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods." (Foresight, 2011).

Note on terminology:

Terminology in the field of environmental migration is important, as it is often imbued with political undertones or designed to frame discussions in a particular way. These issues will be discussed in section 4 below. However, it is necessary to already clarify the terms used in this review.

While the term 'migration' is often assumed to relate to voluntary movements, it is used in this paper to denote all forms of movement, on a spectrum which ranges from voluntary to forced. The term 'displacement' will generally be preferred to 'forced migration'. Displacement refers to situations where the movement is clearly forced, and – in this review - is most commonly used to describe immediate 'flight' from hazards (typically sudden-onset hazards). The term 'planned relocation' will also be used where necessary, to distinguish what is a very specific form of migration, which can be voluntary or forced depending on the specific circumstances but for which the defining characteristic is its managed nature, usually by national public authorities. The term 'human mobility' refers to the ability to move but is increasingly also used as an umbrella term to describe the full range of movement types. – both of these conceptions will be used in this review.

Climate change is probably the most prominent form of current environmental change. Other examples of environmental change include environmental degradation processes which may be interlinked with climate change (desertification) or may not be (maritime, groundwater or radioactive pollution for instance). The terms 'environmental stressor', 'hazard', and 'environmental phenomena' are used broadly in this review to denote both rapid-onset events (such as storms, earthquakes) and slow-onset events, ranging from drought to environmental change processes.

1 Introduction

This literature review provides an overview of the current state of knowledge relating to human migration in the context of environmental change. It begins by looking at the history of research on this theme, and how different approaches often have linkages with the political sphere. Indeed, both migration and environmental/climate change are "hot topics" in contemporary media and political discourse, and even the terms used to frame the issue have clear political implications. The availability of data is then assessed, and the different research approaches summarised, highlighting the difficulties of making predictions about future environmental migration due to the multiple uncertainties affecting both sides of the migration-environment nexus.

Key findings of research to date are then discussed, ranging from prognoses of future levels of environmental migration to considerations of how human mobility articulates with vulnerability in the context of environmental stressors. Given the multitude of research projects conducted on the topic in recent years, this literature review adds value by providing a concise and up-to-date overview on the state-of-the-art of knowledge and categorizing findings in a way that is accessible for a wider audience. The review also highlights key gaps in existing knowledge and data and helps to enhance understanding of how environmental migration relates to vulnerability, risk and exposure.

This review will primarily explore the effects of environmental stressors on human migration rather than the effects of human migration on the environment. Nonetheless, there is a considerable body of literature documenting the latter, both in terms of origin and destination areas, and some consideration of this angle will be given in the analysis of migration-environment-conflict linkages. In some cases, the two causal directions are intricately interwoven, such as when migrant remittances have an impact on land use in the origin area.

This review is aimed at researchers, policymakers, journalists and other representatives of state and non-state organisations who work in related areas, such as migration, climate change, disaster management, development or conflict. To this end, it should provide clear and concise answers to the following questions:

- What are the main challenges in regard to data and methodology?
- Where are the greatest uncertainties regarding future migration flows related to environmental factors? As a result of these uncertainties, are there knowledge gaps researchers cannot bridge at the moment?
- What do we know about how environmental change affects migration?
- How do other factors influence mobility responses in the context of environmental change? How are these intertwined?
- Which factors influence the human agency dimension of migration and how?
- What do we not know?

In short, the literature review aims at answering the question: what knowledge, evidence and data are currently available to inform policymaking related to migration linked to environmental stressors?

2 Methodology of the review

An initial selection of literature was carried out, taking into account:

- relevance to the key themes (existing prognoses, impact types)
- scale of study (a degree of priority was given to large-scale multi-country comparative studies where available. Smaller scale studies were included as well, especially where they brought added value in highlighting particular aspects of a finding)
- date of publication (preference for more recent studies while still taking into account important older publications)
- language of study (preference for studies published in English, and key German-language literature)

The CLIMIG database maintained by the University of Neuchatel,[3] which is dedicated to studies relating to the environment-migration nexus, as well as IOM's research database on the Environmental Migration Portal[4] (which is in part based on CLIMIG) are very comprehensive databases that have been used as key resources for identifying literature to be reviewed.

The review included academic journal articles, government reports, and publications by German and international agencies and institutions working in related areas (migration, development, environment, disaster management, among others).

After this initial review, a second selection was made of studies and publications warranting more in-depth evaluation. The selection of studies was based on the following criteria: number of citations, innovative content, quality of methodology and replicability and generalizability of results.

Findings were organised thematically, based on this structure:

A. General findings
B. Existing prognoses
C. Impact types:
    1) Mobility responses to sudden-onset hazards
    2) Mobility responses in the context of slow-onset hazards
    3) Linkages between environmental change, conflict and mobility
    4) Immobile populations

Findings were recorded in a structured evaluation matrix which provides information on the sources for each key finding, assesses the extent to which findings can be considered reliable, and briefly outlines potential policy implications (see Annex 1). Policy implications and recommendations are the focus of a separate paper, undertaken within the framework of this project (see "Background" above for further information). The evaluation matrix provided the basis for drafting the literature review.

A. General findings

This group comprises a small number of key findings which appear consistently in the literature, and which relate to the human mobility implications of both sudden-onset and slow-onset environmental phenomena.

[3] Climig is an exhaustive bibliographic database of well over a thousand scientific papers and books on climate/environmental change and migration, among them more than four hundred empirical case studies (as of early 2018). The database can be consulted at www.unine.ch/geographie/Migration_and_Climate_Change

[4] http://environmentalmigration.iom.int/research-database

B. Existing prognoses

Various studies have attempted to make quantified predictions about the future scale of environmental migration, but they have been widely criticised due to methodological flaws (Gemenne, 2011; Brown, 2008). This section deliberately focused on studies which have produced quantified projections of future numbers of environmental migrants. Due to the methodological difficulties associated with making such projections, they are not numerous in the literature, meaning the criteria for selection of studies had to be applied in a flexible way. The main objective here was to analyse some of the best-known predictions, highlighting the methodologies used and the critical uncertainties related to them.

C. Impact Types

In general, environmental phenomena are classed as either sudden-onset (such as floods, earthquakes and tropical cyclones) or slow-onset (for instance, sea-level rise, land degradation, drought). While there can be linkages between the two, it is generally agreed that mobility responses differ considerably. The linkages between conflict and mobility can occur in the context of both sudden- and slow-onset environmental stress, and the complexity of these linkages warrants a separate category for this type of impact. The fourth category, 'trapped and immobile populations', relates to those people who are either unable or unwilling to move away from environmental stress (again, whether linked to sudden- or slow-onset phenomena). This dimension of the environment-mobility nexus was brought to prominence by the influential UK government Foresight study (Foresight, 2011), and it has become increasingly clear that some of the people most vulnerable to environmental change could be those who fall into this category (Zickgraf in Mcleman and Gemenne eds., 2018; Milan and Ruano, 2014; Warner et al. 2012).

Selected environmental terms

Negative changes to the environment – 'hazards' or 'stressors' – take many forms. They are usually grouped into two broad categories – sudden-onset events and slow-onset events. Examples of the former include earthquakes, storms and floods. Examples of the latter include droughts, land degradation (including man-made degradation) and sea-level rise.

Hazard

"A potentially damaging phenomenon, substance, human activity or condition that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage." (UNISDR, 2009)

Disaster

"A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources." (UNISDR, 2009)

The term 'disaster' is used for sudden-onset events and drought, but rarely to describe slow processes such as desertification. Nonetheless, slow-onset processes can result in 'disastrous' losses and impacts, particularly with regard to livelihoods.

Exposure

"The presence of people, livelihoods, species or ecosystems, environmental services and resources, infrastructure, or economic, social, or cultural assets in places that could be adversely affected" (IPCC, 2014b: 12) by environmental and climate change impacts.

Vulnerability

"The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt." (IPCC, 2014b: 28)

Resilience

"The ability of a system and its component parts to anticipate, absorb, accommodate, or recover from the effects of a hazardous event in a timely and efficient manner, including through ensuring the preservation, restoration, or improvement of its essential basic structures, identity and functions, while also maintaining the capacity for adaptation, learning and transformation." (IPCC, 2014b: 23; Arctic Council, 2013: viii)

Resilience thus defined can be applied to both natural and human systems. This review is primarily concerned with the resilience of communities, households and individuals to hazards.

Adaptation

"In human systems, the process of adjustment to actual or expected climate and its effects, which seeks to moderate harm or exploit beneficial opportunities." (IPCC, 2014b: 1)

Coping capacity

"The ability of people, institutions, organizations, and systems, using available skills, values, beliefs, resources, and opportunities, to address, manage, and overcome adverse conditions in the short to medium term" (IPCC, 2013:8).

Environmental change

"[C]hanges in the physical and biogeochemical environment, over a large scale, either caused naturally or influenced by human activities" (Foresight, 2011:50) (including industrial accidents), either through fast-onset or slow-onset events. Environmental change includes both environmental degradation and climate change. See also global environmental change.

Climate change

"[A] change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to other natural climate variability that has been observed over comparable time periods" (UN Framework Convention on Climate Change, 1992. Article 1).

Environmental degradation

"The reduction of the capacity of the environment to meet social and ecological objectives and needs. Degradation of the environment can alter the frequency and intensity of natural hazards and increase the vulnerability of communities. The types of human-induced degradation are varied and include land misuse, soil erosion and loss, desertification, wildland fires, loss of biodiversity, deforestation, mangrove destruction, land, water and air pollution, climate change, sea level rise and ozone depletion." (UNISDR, 2009)

The impacts of environmental degradation are often experienced in the form of reduced (or lost) ecosystem services, such as the availability of water or fertile land.

3 History and politics of research on the migration-environment nexus

3.1 References to environmental factors in early migration theories.

The environment as a factor driving migration is not new in the literature[5], though certainly it is currently the focus of unprecedented levels of attention due to climate change and the prevalence of highly destructive disasters. As noted by Piguet (2012), citing key figures in the development of early migration theories such as Ratzel (1882), Ravenstein (1891) and Huntington (1907), "environmental drivers such as climate and soil fertility feature prominently in the first attempts by geographers to systematize knowledge about migration." While these theorisations date back to the late 19th/early 20th century, Piguet notes that subsequently "the environment disappeared" from migration studies through most of the remainder of the 20th century[6], reappearing only in the mid-1980s in the context of work by environmental scientists on the threats posed by climate change and environmental degradation.

3.2 Maximalists versus minimalists (1980s- 2011)

Early research tended to focus on identifying the extent to which migration can be attributed to environmental factors or identifying populations in areas at risk from environmental stressors. Extrapolations based on these types of study provided alarming predictions about the scale of future movements but were generally flawed in terms of methodological rigour (Myers, 1993; 1997; 2002). They have been termed "alarmist" (Suhrke, 1994) and "maximalist", being based on high-end climate/environment forecasts/impacts, and the assumption that all people facing such impacts would migrate in response. Another assumption underpinning this type of research was that all population movement would be forced, hence the use of the term 'environmental refugee' or 'climate refugee' in many of these studies, and that by extension movement in this context was necessarily a negative phenomenon for those concerned.

Recognising the limited validity of such predictions and assumptions, the focus of research in more recent years has moved away from the early focus on numbers to seek to improve understanding of the complex framework in which migration occurs. There is an emerging consensus among researchers since the publication of the influential Foresight study[7] (Foresight, 2011) that environmental factors can have an important role in influencing migration, but migration decisions are influenced by a wide range of 'drivers' at diverse levels. There is general agreement that environmental factors often exert their influence on human mobility indirectly, by exacerbating other drivers (economic or political drivers, for instance). There is also a move towards a more balanced approach to migration in the context of environmental change, with researchers beginning to explore its potential for both negative and positive effects on vulnerability and resilience. The increased understanding of the complexities involved in researching the migration-environment nexus has been accompanied by a corresponding increase in the number of research disciplines engaging in work on this topic (*inter alia* political scientists, geographers, demographers, social anthropologists and migration scholars). Nonetheless, interdisciplinary research studies are still lacking.

[5] For an excellent overview of historical examples of migration linked to environmental factors, see The Atlas of Environmental Migration (2017), pp4-5.

[6] One exception is that provided by Lee's work on migration push and pull factors. In his famous 1966 paper he briefly refers to the natural environment: "a good climate is attractive, and a bad climate is repulsive to nearly everyone" (Lee 1966, 50).

[7] The Foresight study 'Migration and Global Environmental Change' was a large-scale research project led by the UK Government Office for Science, involving over 350 experts from more than 30 countries. More than 70 papers were commissioned, and the final report was published in 2011. It remains to date the largest research project in this field of study.

3.3 Politics of environmental migration

3.3.1 Environmental politics

Beginning in the mid-1980s, a number of researchers and NGOs, motivated by environmental concerns, instrumentalised environmental migration in order to raise awareness and influence policy on the major environmental challenges which began emerging at that time. Using alarming figures for predicted floods of "environmental/climate refugees,"[8] based on simplistic or overly deterministic methodologies, these actors exploited widely held fears relating to mass (in-)migration, in order to raise the profile of environmental issues (notably climate change) on the global policy agenda. Notwithstanding this opportunism, the strategy has been largely successful, with the "flood of climate refugees" thesis still gaining traction in global media outlets up to the present time,[9] and with climate change having secured its seat in global policy debates at the highest level.

3.3.2 Securitization[10] of environmental migration

Studies linking resource scarcity with migration and conflict began to gain traction from the 1980s onwards, based on the work of conflict scholars like Thomas Homer-Dixon (1991; 1994; 1999). Focusing largely on sub-Saharan Africa, these scholars sought to correlate the impact of population growth on the one hand, and reduced availability of natural resources linked to environmental degradation on the other, with increased out-migration and conflict. Suffering from similar shortcomings as the studies described in section 3.3.1 in relation to environmental politics (overly deterministic, simplistic) these studies have nonetheless been drawn upon in the context of debates on climate change. In high-level UN discussions on the security implications of climate change, migration has been presented as a threat to global peace primarily because of its effects on resource scarcity, with migration described as a 'transmission channel' or 'threat multiplier' for its destabilising effects. A more recent study contributing to the 'climate change as threat multiplier' thesis (Kelley, 2015) received widespread attention, having attributed a significant role to climate change and migration in the genesis of the ongoing Syria conflict. Kelley found that a prolonged period (2005-2010) of drought prior to the outbreak of the conflict engendered large-scale net migration of rural farming families to urban centres already facing diverse pressures, thereby contributing to political instability. Other studies have questioned these linkages (see for example Selby et al., 2017).

The prospect of huge influxes of 'climate refugees' can also be instrumentalised for political ends in the context of anti-immigration agendas in countries of the global North where these people would supposedly arrive *en masse*, and bring instability, despite the current lack of evidence for long-distance, international movement among environmental migrants.

3.3.3 Depoliticization of environmental migration?

Some commentators have suggested that migration research which seeks to emphasise the role of households in organising their own migration as adaptation strategies to environmental changes could effectively 'depoliticise' the issue, absolving governments of their responsibilities. Bettini and Gioli (2016)

[8] The term 'environmental/climate refugee', is always placed in inverted commas in this text as there is no legal grounding for it in international law, nonetheless it focuses much-needed attention on the protection challenges related to this form of human mobility. For details see section 8.7.

[9] For example:

https://www.theguardian.com/environment/2017/nov/02/climate-change-will-create-worlds-biggest-refugee-crisis

https://www.cbc.ca/radio/thecurrent/the-current-for-july-26-2018-1.4762425/canada-needs-to-brace-for-wave-of-eco-refugees-in-future-climate-scientist-says-1.4762468

https://gulfnews.com/world/oceania/australia-bracing-for-wave-of-climate-refugees-1.2011504

[10] 'Securitization' in international relations is the process of state actors transforming subjects into matters of "security": an extreme version of politicization that enables extraordinary means to be used in the name of security (Buzan et al., 1998).

have argued that research on 'climate migration' has been 'developmentalised'. They argue that the 'migration as adaptation' discourse which has gained traction in recent years is essentially an uncritical import of the neoliberal/classical strand of the 'migration and development' discourse. While acknowledging it as an improvement on the environmental determinism of earlier theoretical approaches to environmental migration, they underline that the same criticisms which have been levelled at the neoliberal 'migration and development' paradigm are therefore applicable to the 'migration as adaptation' paradigm. In these paradigms, the assumption is that households should 'use' labour migration and the remittances it generates to 'develop' or 'adapt'. Felli (2013, quoted in Bettini and Gioli 2016) questions this assumption:

> *Such an articulation is far from unproblematic, not least as, at the end of the day, it shifts the responsibility (for successful adaptation, for survival) onto the vulnerable. It represents an attempt to individualize climate adaptation in ways that extend a series of neoliberal economic relations that reproduce the conditions out of which vulnerabilities emerge (Felli, 2013).11*

Extending this analysis, Gemenne (2015) argues that the shift away from the use of the term 'refugee' to describe those uprooted by climate change – while understandable from an international refugee law perspective – can also be seen as contributing to de-politicising the issue:

> *By forgoing the term 'climate refugee' we had also de-politicised the reality of these migrations. A central element in the concept of 'refugee' is persecution: in order to qualify as a refugee, you need to be fleeing persecution, or to fear persecution. Forgoing the term 'climate refugee' is also, in a way, forgoing the idea that climate change is a form of persecution against the most vulnerable and that climate-induced migration is a very political matter, rather than an environmental one.[3] For this reason, and contrary to what I might have thought (and written) in the past, and despite the legal difficulties, I think this is a very strong reason to use the term again: because it recognises that these migrations are first and foremost the result of a persecution that we are inflicting on the most vulnerable. 12*

3.3.4 Environmental migration - Research knowledge production

The research agenda has been intertwined with global policy debates, in particular at the UNFCCC (several UNFCCC documents call explicitly for research on the climate change-human mobility nexus) and in the framework of the Nansen Initiative.[13] This has allowed researchers to bring evidence to policymakers in a structured and continuous way – not necessarily the case in other migration-related fields. However, Nash (2018) notes that this strong interrelationship between the policy sphere and academia may be causing a "self-perpetuating circle of research, policy, and knowledge production" in which "the ones involved in policymaking, supporting calls for increased knowledge, and carrying out research and creating knowledge products in order to respond to these calls are all the same actors."

Regardless of what the current reality may be in regard to these different political analyses of environmental migration research, Veronis makes a good point in stating that "It is a worthwhile exercise for environmental migration researchers to take time to think more critically not only about what is being studied, but also to what end or purpose" (Veronis, in Mcleman and Gemenne [eds], 2018, p54).

[11] Bettini & Gioli (2016) Waltz with development: insights on the developmentalization of climate-induced migration. *Migration and Development*, p13

[12] Gemenne, F. One good reason to speak of 'climate refugees'. *Forced Migration Review* No. 49, 2015, p70. University of Oxford.

[13] The "Nansen Initiative on cross-border displacement in the context of disasters and climate change" was a State-led international consultation process (launched in 2012), which led in 2015 to the adoption of the "Agenda for the Protection of Cross-Border Displaced Persons in the Context of Disasters and Climate Change' by government ministers and officials from over 100 countries. See www.nanseninitiative.org

4 The significance of terminology

Terminology is an important consideration in regard to the study of the migration-environment nexus. This is because different terms imply different rights and obligations and involve different actors.

Researchers approaching the topic from the 'minimalist' perspective are unlikely to even use the qualifiers 'environmental' or 'climate-induced' to describe movements in this context, as it would be – in their view – over-emphasise the role of the environmental driver(s) at play. In academic and policy settings, the use of 'environmental' as qualifier is more common than 'climate', the latter being used where the objective is to focus on the impacts of climate change. The term 'environmental' is often preferred because it can be difficult to attribute a direct cause-effect relationship between climate change – a global long-term process – and a time- and context-specific migratory movement. For instance, it is impossible to attribute a specific natural hazard to climate change, as there is nothing to prove the event would not have occurred regardless. 'Environmental' is much broader, covering climatic and non-climatic, and natural and man-made events and processes.

As regards the term used to describe the movement, there has been a great deal of debate in academic and policy circles. 'Environmental migration' is a commonly used term, which is often accompanied by the definition proposed by IOM in 2007:

> *"Environmental migrants are persons or groups of persons who, for compelling reasons of sudden or progressive changes in the environment that adversely affect their lives or living conditions, are obliged to leave their homes or choose to do so, either temporarily or permanently, and who move either within their country or abroad".*

This is a deliberately broad definition designed to capture the complexity and diversity of movements and is not intended to have a normative/legal purpose or have implications for the granting of rights. It is nonetheless not the subject of consensus, since there are a range of competing definitions for the term 'migration'. Some scholars (and policymakers) use 'migration' only to refer to voluntary movements, while for others (including IOM[14]) the term migration encompasses all types of movement (forced and voluntary, temporary and permanent, internal or international).

The term 'displacement' is widely used on all sides to describe forced movements (most commonly in the context of disasters), but it also has some implications, as it is derived from an internationally agreed definition of Internally Displaced Persons (IDPs) enshrined in the (non-binding) UN Guiding Principles on Internal Displacement.[15]

Those wishing to emphasise the forced nature of the movement have (and sometimes still do, as proposed by Gemenne (2018)) used the terms 'climate refugee' or 'environmental refugee'. This often reflects a desire to advocate for/assert the rights of affected people to assistance or compensation. However, it has no basis in international law, as the international legal definition of 'refugee' designates those fleeing persecution on the grounds of race, religion, nationality, political opinion or membership in a particular social group. For this reason, the term is rarely used in academic study, but still appears regularly in advocacy literature and the media.

The term 'human mobility' – which originally relates only to the *ability* to move, has been increasingly used in recent years as a more politically neutral 'umbrella term' to describe all forms of movement

[14] IOM Definition of "Migrant":

IOM defines a migrant as any person who is moving or has moved across an international border or within a State away from his/her habitual place of residence, regardless of (1) the person's legal status; (2) whether the movement is voluntary or involuntary; (3) what the causes for the movement are; or (4) what the length of the stay is. (source: www.iom.int/who-is-a-migrant)

[15] See http://www.internal-displacement.org/publications/ocha-guiding-principles-on-internal-displacement

relating to environmental factors (voluntary migration, displacement, planned relocation).[16] It is common to see the term formulated as 'human mobility in the context of climate change' or related variants. Its growing usage is likely also a reflection of increased awareness among researchers of the linkages between environmental events and people being unable or unwilling to move as a response ('immobility'), an issue discussed in section 7.5 below and in more detail in the accompanying paper focused on impacts.

The term 'planned relocation' refers to a very specific form of migration, which can be voluntary or forced depending on the specific circumstances but for which the defining characteristic is its managed nature, usually by national public authorities. 'Relocation' is preferred to 'resettlement' in policy circles, as resettlement is the term used for movements in the context of the 1951 Refugee Convention.

[16] An indication of this evolution in vocabulary is the choice of name for the "Advisory Group on Human Mobility", established in 2013, which provides inputs to the UNFCCC process.

5 Theoretical approaches

References to environmental factors in theories seeking to explain migration pre-date the recent upsurge in research on the migration-environment nexus linked to growing global concern about climate change.[17] Indeed, as described above, the environment was identified by early theorists of migration at the end of the 19th century. However, during the twentieth century economic factors were generally at the forefront, with neoclassical theory (Lewis, 1954; Harris and Todaro, 1970; Borjas 1989) emphasising individual assessments of income differentials between origin and destination areas leading to movement of people, and historical-structuralist theories emphasising migration as part of a system that keeps marginalised, exploited countries dependent on the countries controlling the levers of capital and labour ("dependency theory" – see Frank, 1966; and "world systems theory" – see Wallerstein, 1974). The "push-pull" model made famous by Lee (Lee, 1966) brings back consideration of factors beyond the economic sphere (notably demographic) but remains focused on decisions taken at the level of the individual, similar to neoclassical approaches.

A new perspective, which still focused on economic factors, came to the fore in the 1980s, the New Economics of Labour Migration (NELM) (Stark and Bloom, 1985; Lucas and Stark, 1985). NELM changed the level of analysis, moving away from neoclassical theory's focus on individuals or structuralists' focus on the global system of countries. Instead, under NELM, migration results rather from income maximization and risk management strategies implemented by households (Massey & Parrado, 1998; Stark & Levhari, 1982; Taylor, 1999). Following this analysis, households, select a suitable candidate(s) for migration from within the household. In this approach, migration of one of more household members allows the household to 'spread' the risk stemming from its exposure to economic shocks, by ensuring a diversification of income sources through remittances. In this way, migration constitutes a sort of substitute for insurance (Massey et al., 1993; Yang & Choi, 2007). The extension of this reasoning to environmental shocks (Arango, 2000) enables a useful application of the NELM approach in the analysis of environmental migration, although as discussed in section 3.3.3 ("De-politicisation of environmental migration') this transposition is not without its critics.

Although not focusing specifically on migration, the sustainable livelihood perspective[18] emerged in parallel to NELM and has been increasingly used in research into the environment-migration nexus. The sustainable livelihood perspective also focuses on the household and posits that migration is often a key avenue for rural households to diversify their livelihood and reduce environmental risk, alongside other options such as intensification of farming methods (by use of fertilisers for instance), or extensification (cultivation of additional land) (Hussein and Nelson, 1998; Bebbington, 1999; Carney, 1998; Ellis, 2000; McDowell and De Haan, 1997). The household's natural, financial, physical, human, and social capital are the determinants of a household's livelihood strategy (i.e. which options are available).

NELM and the sustainable livelihood approach complement each other (De Haas, 2010) and have been drawn on extensively by scholars of environmental migration seeking to illuminate the more positive dimensions of migration in response to environmental stressors (see for example Warner and Afifi, 2014). Under the NELM perspective, migration is used to mitigate the risk posed by environmental shocks (floods, storms, drought and so on) on household income, with remittances often 'spiking' to meet increased needs at such moments (money for food and other basic items to survive the immediate effects, and subsequently for recovery-related activities such as re-building damaged homes, replacing damaged farm infrastructure or equipment). Under the sustainable livelihood perspective, migration represents a

[17] For a more detailed consideration of references to environmental factors in migration theories, see Piguet (2012). For a comprehensive overview of migration theories, see De Haas (2010) or Castles et al (2013).

[18] "A livelihood comprises the capabilities, assets and activities required for a means of living. A livelihood is sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities and assets both now and in the future, while not undermining the natural resource base." (DFID, 2001)

potentially important option for households to address the erosion of livelihoods caused by environmental stressors (climate change, land degradation, water shortage, among others), assuming that the same stressors are not present at the migrant's destination.

Network theory posits that households possessing 'social capital' in the form of a network of friends/family/kinship contacts already established in potential destination areas, are able to migrate/send a migrant at much reduced cost and with much reduced risk of failure to establish a livelihood at the destination, and that each new migrant contributes to the dynamic, driving the growth of migrant communities. The 'transnational' and 'translocal' strands of network theory posit that migrants are increasingly likely to maintain close ties with origin areas (family ties, community ties) and often 'circulate' between origin and destination areas, sometimes over entire lifetimes (Greiner and Sakdapolrak, 2013; Etzold, 2017). Circulation might be physical (family visits, oversight of land cultivated, other investments) and/or virtual, facilitated by the internet and other technological advances. A number of scholars have drawn on network theory to demonstrate how migration can contribute to the resilience of communities impacted by environmental stressors, via similar mechanisms to those at play in NELM and sustainable livelihood perspectives (spreading of risk across locales, economic and social remittances). For example, Deshingkar (2011) and Scheffran et al. (2012) found evidence for the transfer of knowledge relating to more resilient agricultural techniques.

The Foresight study: Migration and Global Environmental Change

Seeking to recognise the complexity of migration, and drawing on these different theoretical strands, the Foresight project (Foresight, 2011), developed a 'conceptual framework' diagram which has been widely used and cited in research and policy circles since the publication of the study's findings in 2011 (figure 1). In this framework, mobility outcomes (migrate or stay) are shaped not only by macro-level drivers (environmental, economic, political and so on.) but also by intervening factors at the 'meso' level (e.g. access to migration networks), and factors at the 'micro' level (such as age, gender, individual agency, household composition and so forth.). In this way, the Foresight approach transcends the structure-agency dichotomy, while also reflecting the theoretical contribution of network theory. In the Foresight framework, mobility outcomes are highly context-specific, making it extremely difficult to make predictions about the future, and indeed the study explicitly refrains from any effort to make specific predictions about future numbers.

Figure 1: Foresight conceptual framework for migration decisions

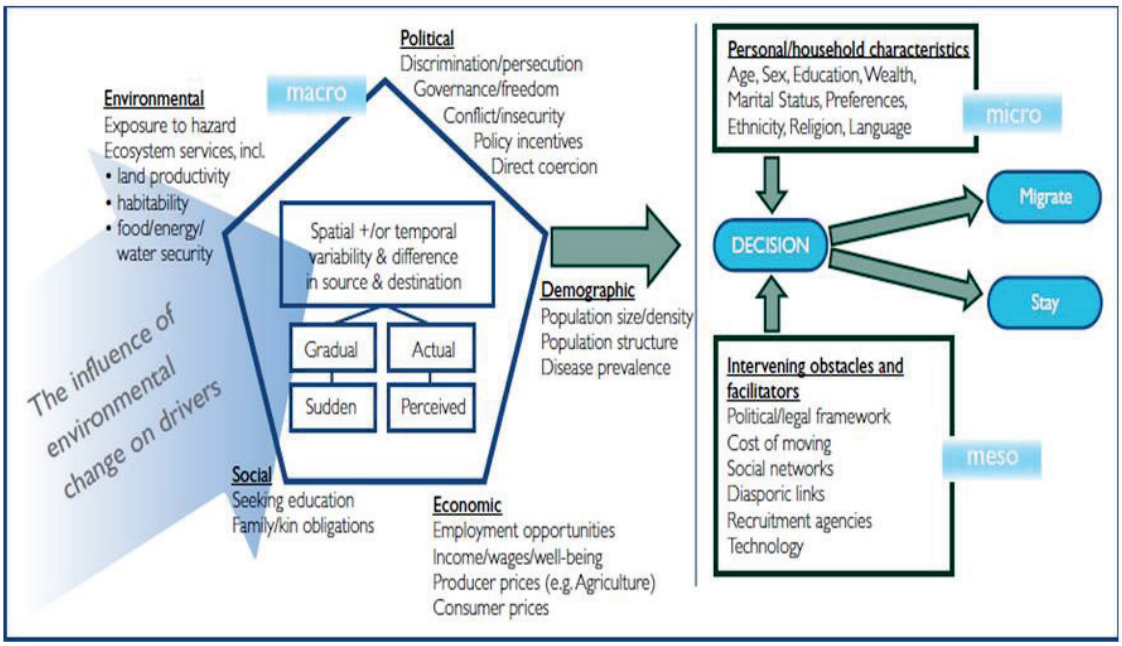


Figure from: Foresight: Migration and Global Environmental Change (2011) Final Project Report, The Government Office for Science, London, P. 12.

6 Methodological considerations

6.1 Data challenges[19]

Existing ***data on migration*** are often incomplete, especially in developing countries, such as data on internal, temporary movements, which constitute a large proportion of environmental migration. A general problem is the lack of long-term historical ('longitudinal') data on migration, which 'fit' with the slow timescales of environmental change processes.

Data on displacement in the context of sudden-onset natural disasters are more widely available, but are often limited to estimates of numbers displaced, and often do not indicate duration or geographical patterns of displacement or provide insights into the impacts on people's vulnerability. Annual estimates for the number of people displaced within their country by sudden-onset events (floods, earthquakes etc.) have been produced since 2008 by the Internal Displacement Monitoring Centre (IDMC) but are subject to a number of limitations. In the absence of reliable national reporting mechanisms, IDMC data are based on triangulation of different data sources for each displacement event, and – when available data is in the form of homes destroyed - extrapolations from average household-size figures. This leaves a considerable margin for inaccuracies.

It is also important to note that data on distance, duration and severity of displacement are not usually available. For example, data do not allow to distinguish between evacuation to designated shelters/camps or spontaneous dispersal (such as sheltering with friends or relatives). Furthermore, IDMC's estimates are for people *newly* displaced in a given year - there are no figures for 'stocks'[20] of people displaced by these events as there are for UNHCR-recognised refugees. This means there is a potential for duplicate counting in cases of multiple disasters affecting the same location within a given year. With these caveats in mind, IDMC found that natural disasters have generated 265.3 million "new displacements" between 2008 and 2018, representing an average of 24 million per year, with floods, storms and earthquakes constituting the principal sources.[21]

Absolute versus relative displacement

When discussing global disaster displacement figures, it is extremely important to keep in mind that countries showing the highest absolute displacement figures are often not the worst affected. For example, in 2017 displacement caused by the Atlantic hurricane season was high in the USA (over a million), but in the small Caribbean island state of Dominica the figure was comparatively low, at 35,000. But in relative terms, the displacement (and other impacts) was much worse in Dominica: 47.4% of the population, compared to approximately 0.4% in the USA (IDMC, 2018).

Information on movements in the context of drought and slow processes (such as sea level rise, land degradation) is not widely collected. The Emergency Events Database (EM-DAT) on disasters[22] provides data on numbers of people affected by drought, which can provide an idea of the scale of drought impacts

[19] This section is adapted from *IOM Manual on Migration, Environment and Climate Change* (IOM, Geneva, 2016). For a more detailed overview of existing data and associated limitations, please refer to: https://migrationdataportal.org/themes/environmental_migration

[20] "Stocks" refer the number of a category of people (here, people displaced internally by disasters) in a place at a given time. They are different from "flows", which indicate the number of people in a given category having moved within a given time period.

[21] For details of their estimates for disaster displacement in 2017, including breakdowns by country, please see: Global Report on Internal Displacement [GRID] (IDMC, 2019).

[22] www.emdat.be

but not related movements. IDMC notes that according to EM-DAT figures, more than 686 million people across Africa and Asia were affected by drought between 2008 and 2018, more than earthquakes, storms and floods combined (IDMC, 2018).

IDMC has recently begun to gather data on drought-induced movements, but it is important to note that IDMC's focus is on *displacement*, not more voluntary forms of movement which may nonetheless be related. This, combined with the presence of diverse drivers of movement in many drought situations, is a key methodological challenge for collecting data on movements relating to drought. Keeping this in mind, IDMC was able to estimate drought-displacement for four major droughts in 2017. Using a defined methodology with cross-checked data, IDMC estimated that 1.3 million people had been displaced by the 2017 droughts in Burundi, Ethiopia, Madagascar and Somalia (IDMC, 2018). For other major droughts that year – such as in Angola, Chad, China, Mauritania and Niger, where EM-DAT figure indicate 10 million people were affected by drought – it found that data were insufficient to allow for the provision of an estimate.

For both sudden- and slow-onset events, most of the data available are presented as aggregate numbers only, giving little or no indication as to how different demographic groups – in particular, men, women, girls and boys – are impacted.

The lack of statistics that are disaggregated by sex and age is a particular concern since this limits understanding of the vulnerability, resilience and needs of specific sub-groups. This information is crucial in order to improve response strategies and provide effective, targeted/tailored support and assistance to affected populations.

In general, ***data on environmental parameters*** is much more readily available than migration data. Numerous databases are available, holding reliable data at high temporal and spatial resolution (land cover, land degradation, climate data and so on. For an overview, see Neumann and Hilderink [2015]). Data on land use are often contained in censuses. There can nonetheless be challenges relating to environmental data, such as the lack of climate change projection data at a sufficiently downscaled level (i.e. at a spatial resolution useful to the geographical area being analysed).

6.2 Uncertainties

Beyond the data issues outlined above, researching environmental migration is extremely challenging due to the multiple uncertainties involved, on both sides of the equation.

- Nature of climate change (e.g. tipping points[23])
- Future extent of environmental change
- Future levels of/possibilities for adaptation (Klein et al, 2014)
- Complex nature of human vulnerability to environmental change
- Complex nature of individual mobility responses (importance of individual perception etc.)

On the environmental side, there are considerable uncertainties about the nature of climate change (such as the "non-linear" climate system tipping points for instance) and the future extent of environmental change, which will depend on a number of factors (how deeply and how quickly will carbon emissions be

[23] The IPCC defines a tipping point as: "A level of change in system properties beyond which a system reorganizes, often abruptly, and does not return to the initial state even if the drivers of the change are abated. For the climate system, it refers to a critical threshold when global or regional climate changes from one stable state to another stable state. The tipping point event may be irreversible." (IPCC, 2014 – Synthesis Report – Annex II – Glossary, AR5)

reduced, if at all? How much will temperatures rise? How much in a specific region? How bad will land degradation get?).

Human responses to environmental change also bring major uncertainties. For example, how much will be invested in supporting adaptation to climate change (such as sea defence systems, land rehabilitation initiatives)? What new technologies might become available (e.g. improved versions of drought-resistant crop varieties)? Investment in human capacities will also shape adaptive capacities, by building awareness of risks and opportunities. New technologies can have a major role in securing livelihoods, but their potential is shaped by investments in societal knowledge and capacity building.

Since vulnerability to environmental stressors is a key influence on migration decisions, a whole range of non-environmental factors will also strongly influence environmental migration in the future, such as economic growth trajectories and governance models pursued (Foresight, 2011). For instance, vulnerability is likely to be lower in inclusive, prosperous societies where social safety nets are in place, and everyone can access key public services (water, electricity etc.). But uncertainty surrounding these kinds of variables is immense, even over relatively short time frames.

Finally, there remains considerable uncertainty linked to the importance of individual agency in migration decisions. For example, perception can be even more important than objective realities (e.g. the perception that one's land will still be fertile enough despite expected degradation). Cultural factors such as "affective and social ties to location" can also mean people choose to stay when faced with environmental impacts which reduce the viability of their livelihoods (Adams, 2016).

6.3 Research approaches

A growing range of research approaches is used to study the environment-migration nexus, with recent years having seen the application of innovative modelling techniques, and a number of large-scale, multi-country studies.[24]

Qualitative or ethnographic methods:

This type of study, which involves researchers going into the field and gaining insights via face-to-face contact with people affected by environmental phenomena, is a common approach (Warner, in Vargas [ed] 2011; Rademacher-Schulz et al, 2012). Information is typically collected through interviews and small-scale surveys, but often also draws on participatory rural appraisal (PRA) techniques such as Focus Group Discussions and Resource Mapping. Qualitative studies allow researchers to gain insights that cannot be obtained through quantitative approaches focused on large datasets. For example, qualitative studies can reveal the importance of factors specific to the area of study and take account of difficult-to-measure dimensions like individual perception of risk. However, findings from this kind of study are often difficult to apply to broader scales due to the specificities of local context.

Modelling techniques

Modelling based on common statistical techniques such as correlation analysis and regression analysis is widely used in the study of environmental migration, with the objective of measuring the strength of environmental drivers' impacts on migration. Regression analysis allows researchers to 'isolate' the influence of selected environmental variables on observed migration data, in relation to other variables (for instance economic, or demographic). These relationships can be used to project future levels of environmental migration (for example, Feng et al, 2010; Bohra-Mishra et al, 2014). Modelling requires quantified data-sets which are often not available, particularly longitudinal data on migration (see 'Data challenges' above). The choice of environmental variable(s) measured (often as a proxy for climate

[24] More detailed critical analysis of methodologies used in certain studies cited is provided in Annex 1: Evaluation Matrix.

change) can have a significant influence on results, with some studies using rainfall, some temperature, others using soil quality to name a few. The same applies to the type of migration variable measured (all forms of migration or only permanent? Individual or whole of household?)

Innovative research methods are gradually being applied to the migration-environment research domain, such as Agent-Based Modelling (ABM), which puts the individual at the heart of the analysis and allows for the integration of heterogeneous hypothesized behaviour response relationships (see for example Kniveton et al, 2011; Hassani-Mahmooei and Parris, 2012; Warner et al, 2012; Kniveton et al, 2012). Probabilistic Risk Assessment methodology has only been applied systematically in recent years, notably by the Internal Displacement Monitoring Centre (IDMC) to measure disaster displacement risk. IDMC has also pioneered the application of System Dynamics modelling in this domain, to model displacement risk for pastoralists in East Africa. Gravity models have also been used. In 2008 Warner and Afifi used such a model to analyse international environmental migration (but without providing estimate figures), and in 2018, the World Bank published results in its 'Groundswell' report, based on a global-scale study which models future *internal* environmental migration, an interesting development in environmental migration research.

Another very recent innovation has been the use of "big data."[25] Recent studies have been able to use mobile phone users' anonymised call data records (CDR) to track population movement in the aftermath of disasters or patterns of internal and circular migration which are typically hard to capture using traditional sources of data like national censuses and household surveys (Lu et al, 2016; Blumenstock, 2014; Bengtsson et al, 2011).

A very 'hands-on' innovation – for cases where data is not available – is the use of aerial photographs obtained from Unmanned Aerial Vehicles (UAVs) such as drones, to map/plan data collection, such as sampling strategies for household surveys. This was used in Haiti in 2015 in the framework of the MECLEP project, to select sub-blocks in which to carry out the survey (Milan et al, 2015).[26]

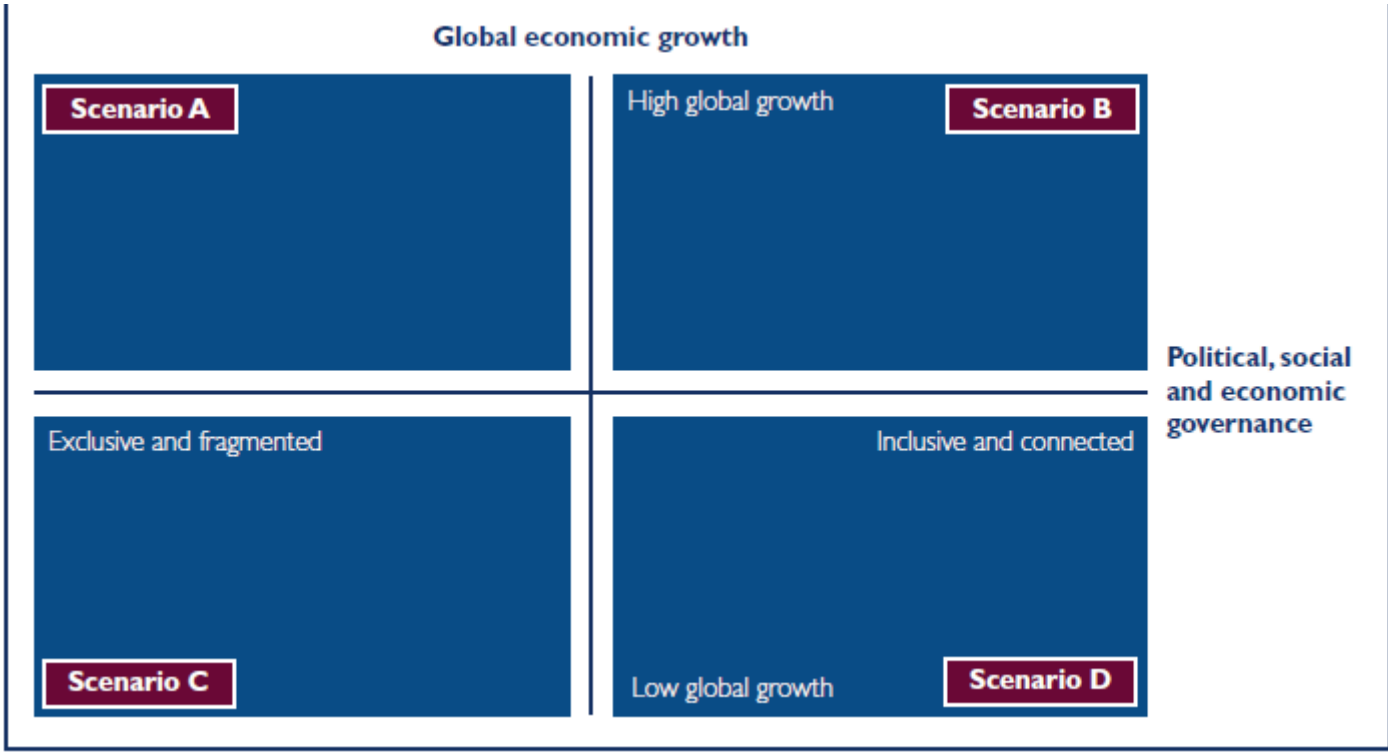
Scenario planning

The use of scenario testing, while not new, has only been applied to this field of study in recent years, notably via the highly regarded 'Foresight' study published in 2011 (UK Government Office for Science). Scenario testing allows researchers to account for multiple uncertainties and potential 'non-linear' evolutions of variables and allows policymakers to test the robustness of policy interventions. The diagram below shows the four scenarios used in the Foresight study, with different combinations of economic growth and governance model.

[25] "Big Data" is an umbrella term referring to the large amounts of digital data continually generated by the global population. A large share of this output is 'data exhaust'," or records generated as a by-product of everyday interactions with digital products or services. (UN, 2013)

[26] With the approval of authorities and local communities. This is an important pre-requisite for using this tool. For details see https://environmentalmigration.iom.int/meclep-highlights

Figure 2: Scenarios used in the Foresight study



Source: Foresight, 2011: 63, Figure 2.5. Scenarios to show plausible future states of migration drivers

7 Key findings

7.1 Existing data and prognoses

Various studies have attempted to make quantified predictions about the future scale of environmental migration[27], but most have been widely criticised due to methodological flaws. This section will analyse some of the best-known predictions, highlighting the methodologies used and the critical uncertainties related to them.

The vast majority of prognoses have looked at migration relating to *slow-onset* environmental stressors, such as land degradation and sea-level rise, and are the focus of attention in this section. However, it is also important to consider displacement resulting from *sudden-onset* events. The vast majority of such events, and the displacement they generate, are weather-related events (such as floods, storms, heatwaves). Climate change is widely predicted to result in an increase in the frequency and intensity of extreme weather events (IPCC, 2012:10-13), therefore this type of displacement may become increasingly significant in the future. The most recent special report by the Intergovernmental Panel on Climate Change (IPCC) indicates warming of 1 degree Celsius above pre-industrial levels has already occurred (more in some regions), and that we are already seeing impacts (IPCC, 2018).[28]

7.1.1 Displacement caused by sudden-onset disasters

Using their own data and a modelling of disaster displacement since 1970, IDMC has been able to develop estimates of those at risk of being displaced in the future by such hazards, using Probabilistic Risk Assessment methodology (Ginnetti, 2015). IDMC's projections show a clear upward trend. Important explanatory factors for this trend include population growth (increased exposure), improvements in disaster preparedness (more people survive disasters, but therefore more are displaced), and improved reporting of disaster impacts since the 1980s. However, "while population growth accounts for some of this increase in displacement, the risk of displacement is increasing twice as fast as the world's population is growing" (Ginnetti, 2015: 19)

Figure 3: IDMC's Disaster-Displacement Risk Index (10-year projection)[29]:

Focus Region	Population	Average Annual Displacement Risk	Relative Annual Displacement (per 1 million people)	Annual change in displacement risk
S Asia	1,730,000,000	9,200,000	5,300	3.7%
SE Asia	1,990,000,000	30,000,000	15,100	2.4%
S Pacific	10,800,000	45,600	4,200	2.4%
LAC	186,000,000	809,000	4,300	2.5%

Source: Ginnetti, 2015: 23[30]

Criticisms of these figures include the fact that – as acknowledged by IDMC - the projections assume a 'business as usual' scenario in which natural hazards occur with the same frequency and intensity as in the past and population growth and changes in exposure and vulnerability occur at current rates. However, since climate change is expected to increase the frequency and intensity of this type of hazard,

[27] Attempts have also been made to estimate the current numbers. For an overview, see Gemenne (2011), pp 42-44.

[28] For example: "Trends in intensity and frequency of some climate and weather extremes have been detected over time spans during which about 0.5°C of global warming occurred (medium confidence)." IPCC (2018: 4)

[29] Projections are also available by country within these regions, and by hazard type.

[30] LAC = Latin America and the Caribbean.

these figures may therefore constitute an under-estimate. Also, it is not possible to equate risk of displacement with actual displacement – there are many uncertainties at play, such as future levels of disaster risk reduction (DRR), population growth and so forth. Finally, the projections are built on data which are subject to uncertainty as regards their accuracy (see section 6.1 for details).

7.1.2 Migration related to slow-onset environmental phenomena[31]

Initial estimates for those moving due to slow-onset environmental phenomena were developed in the 1980s and 1990s, with the "200 million by 2050" estimate made by Professor Norman Myers in 1997 becoming something of a reference figure in the media, and cited in the influential Stern report on climate change (2006) and many other studies. However, by Myers´ own admission, this projection was based on "heroic extrapolation" (cited in Brown, 2008:12), and pieces together data from various sources based on different methods. Crucially, it assumed that all those affected by such phenomena would move, which neglected various uncertainties, not least of which that relating to the 'human agency' variable.

Due to the multiple uncertainties surrounding future migration in the context of environmental change, the Foresight study (2011) explicitly abstained from making any quantified predictions, however it did present a range of striking data for the numbers of people at risk from various environmental change-related stressors. For example, Foresight estimated that population levels in Low Elevation Coastal Zones[32] (i.e. 'at risk') are set to increase dramatically across varying scenarios of the future, a combination of natural population growth and rural-urban migration. While not data on migration per se, these figures can at least provide policymakers with orders of magnitude for the different challenges faced.

> THE POPULATIONS LIVING IN URBAN FLOODPLAINS IN ASIA MAY RISE FROM 30 MILLION IN 2000 TO BETWEEN 83 AND 91 MILLION IN 2030, AND THEN TO 119–188 MILLION IN 2060 ACCORDING TO DIFFERENT SCENARIOS OF THE FUTURE. (Foresight, 2011: 19)

A recent study by the World Bank, "Groundswell – Preparing for internal climate migration" (2018) uses a gravity model approach for three different scenarios to predict future internal migration linked to environmental change. It finds that by 2050 — in just three regions: Sub-Saharan Africa, South Asia, and Latin America — climate change could force more than 143 million people — or around 2.8 percent of the population of these three regions — to move within their countries to escape the slow-onset impacts of climate change, unless concerted action is taken at the national and global levels. The report finds that internal climate migration will likely continue to rise beyond 2050 and then accelerate unless there are significant cuts in greenhouse gas emissions and "robust development action". While the methodology employed is innovative and rigorous, some points are worth keeping in mind. As acknowledged in the report,

> The scope of internal migration definition is limited: "The modeling work captures people who move at spatial scales of over 14 kilometers - within a country - and at decadal temporal scales. Shorter distance or shorter-term mobility (such as seasonal or cyclical migration) is not captured."[33] Seasonal and cyclical migration have widely been found to be very important dimensions of environmental migration in the regions studies, so this is a significant limitation to the report's scope/validity. Furthermore, while internal movements are predominant, people will also cross borders, which the World Bank figures cannot account for.

[31] More detailed critical analysis of methodologies used in certain studies cited is provided in Annex 1: Evaluation Matrix.

[32] LECZs are comprised of the contiguous area along the coast that is less than 10 metres above sea-level

[33] World Bank (2018: vii)

"Gravity model approaches are largely silent on the question of individual motivations for migration."[34]

7.2 Near- far

Environmental migration, similar to migration more generally, usually occurs within countries (Obokata, Veronis and Mcleman, 2014; Foresight, 2011; Findley, 1994). Furthermore, internal migration is often very local, and usually to nearby towns and villages (Warner et al, 2012). Various factors help to explain why this is the case. A key consideration is cost; international migration is expensive. Where international migration has been documented, it is generally to neighbouring countries (Obokata, Veronis and Mcleman, 2014). Social capital is another important factor – people tend to choose destinations where they have contacts, people who can assist them with finding work and accommodation and help them settle in (refer to discussion of network theories above) (Tacoli, 2011; Foresight, 2011). Such networks reduce the costs of migration and associated risks. Immigration restrictions in potential destination countries are another important explanatory factor.

Many studies have found evidence that the environment is one of the factors driving internal migration (Foresight, 2011; Warner et al, 2012). Several studies have found links between environmental change (average temperature, rainfall, rainfall variability) and increased out-migration from rural areas. Seasonal migration out of rural areas during the 'dry season' or the 'flood season' has also been widely documented, not necessarily linked to broader environmental change (Rademacher-Schulz et al, 2014; Warner et al, 2012; Foresight, 2011). Such migration may be to other rural areas with different agro-meteorological cycles, often undertaken by male heads of household. This kind of migration may also be to nearby areas, often for work in low-skilled wage labour, domestic work, petty commerce (Tacoli, 2011). There is some evidence of gendered migration patterns in relation to environmental factors. For instance Gray (2010) found that environmental degradation was a complex determinant of mobility patterns in rural Ecuador, with both women and men migrating internally, but international migration more likely to be undertaken by men from land-rich households, which underlines the need for substantial resources to undertake international migration. The Where the Rain Falls research study (Warner et al, 2012) found evidence that some people moved in a "stepping stones" pattern, from smaller, nearby towns to larger, more distant cities (see Zelinksy, 1971).

Movements linked to sudden-onset disasters are often complex, multi-stage and shaped by the range of micro-, meso- and macro-level factors presented in the conceptual framework in section 5 (Figure 1). Immediate 'flight' to ensure survival is usually to the nearest safe place and may be only a matter of metres. Many people move a few kilometres to camps or to stay with friends and relatives in the surrounding area. The latter are hardly ever captured in official statistics. However, subsequently people may move further afield to find work, whether as a whole household or a particular member of the household. The decision will be heavily influenced by the expected duration of recovery and rehabilitation, among other factors. Some may settle permanently at the site to which they have been displaced ("local integration" in the lexicon relating to Internally Displaced Persons ["IDPs"] and refugees), while others may settle far away, sometimes with the assistance of authorities (e.g. relocation of Montserrat residents to mainland Britain following the volcanic eruption there in 1995[35]).

There are a number of detailed studies documenting the diverse post-disaster mobility patterns for certain disasters, such as Hurricane Mitch (1998, Honduras/Central America), Hurricane Katrina (USA, 2005), the Haiti earthquake (2010), Typhoon Haiyan/Yolanda (The Philippines, 2013) and the 2015 earthquake in Nepal. In the case of Hurricane Mitch and the Haiti earthquake, researchers have

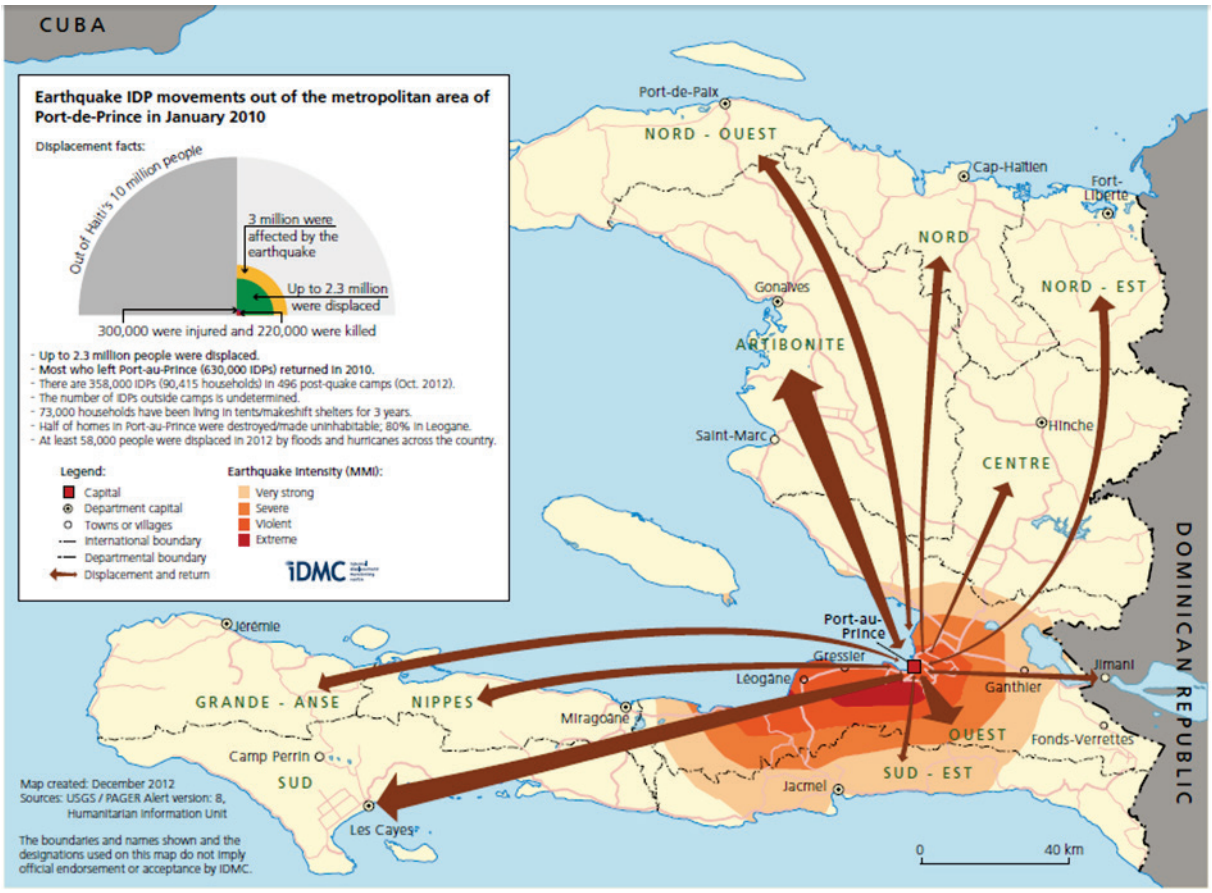
[34] World Bank (2018: 53)

[35] https://www.theguardian.com/environment/2005/jul/18/g2.naturaldisasters Accessed 29/10/2018.

documented multi-stage movements across international borders, with some Haitians having moved as far as Brazil (IOM and PUC Minas, 2014), and many Hondurans having moved to the USA in the wake of Hurricane Mitch (Kugler, 2006).

Movements related to drought vary greatly, depending in part on the severity of the drought. Some studies have shown the use of local, short-term migration as a coping strategy. Findley's (1994) often-cited study of migration in Mali during the recurrent droughts of 1983-1985 found that remittances from international migration were a vital resource for affected communities, but that international migration decreased during this period as households no longer had the requisite financial resources to send migrants abroad. Instead, local short-term migration was used as a coping strategy. The acute Horn of Africa drought of 2010-2011 – taking place in an existing context of conflict and vulnerability – resulted in massive and clearly forced movements across long distances – including across borders - to access international assistance, with many remaining displaced for long periods.

Figure 4: IDP movements out of the metropolitan area of Port-au-Prince, Haiti, in January 2010



Source: IDMC, 2012

7.3 Temporary-permanent

7.3.1 Temporary, seasonal, circular migration

As described in the preceding section, temporary (often seasonal) migration has been widely documented in response to environmental stressors, and increasingly understood as an integral part of livelihood and/or food security strategies (FAO, 2018). The level of the household's capital (financial and social capital, for instance) is an important determinant of duration (as well as distance). Findley (1994) and Henry et al. (2010) both found that longer-term migration - particularly by men - decreased in drought

years (in Mali and Burkina Faso respectively), but the short-term mobility of women and children increased.

In recent years, several studies have sought to explore in more detail how temporary movements articulate with environmental change. The concept of circular migration, a fairly recent construct in migration and development theory, has been increasingly applied to studies of environmental migration. Circular migration posits that many migration 'trajectories' are composed of a series of movements between origin and destination areas (sometimes over long periods / decades), with migrants developing and maintaining strong ties to both, and often bringing positive developmental contributions to origin areas beyond remittances. According to this conception, circular migration can therefore be mobilised to support adaptation to climate/environmental change.

7.3.2 Permanent autonomous out-migration

Permanent out-migration tends to occur when environmental degradation becomes acute or irreversible, and livelihoods become unsustainable. Autonomous out-migration generally occurs household-by-household, as each reaches its own coping/non-coping threshold.36 Movement is undertaken autonomously, i.e. without assistance from authorities. A famous example is that of the partial drying of the Aral Sea (Uzbekistan), caused by large-scale irrigation projects. Since the 1960s, around 100,000 people have moved away, principally due to the destruction of fishing and related livelihoods (Foresight, 2011:13). A more recent study in Indonesia (Bohra and Mishra, 2014) established a causal link between temperature rise (and to a lesser extent reduced rainfall) and permanent out-migration at the inter-province level.

7.3.3 Permanent relocation

Permanent relocation of whole communities by public authorities is widely expected to become increasingly necessary as environmental change processes take hold.[37] There are already several examples, such as the relocation of hundreds of thousands of people in China's Inner Mongolia region, caused by land degradation (natural and man-made) on a vast scale (Yang, 2014).). High exposure to sea-level rise and extreme events in Vunidogoloa (located on the second largest island of Fiji, Vanua Levu) led to a relocation process that was begun in 2006, with assistance from the government and international organisations. The selection of the destination site was made by the people being relocated, a factor that was deemed critical to the relocation's success (Tronquet, in Gemenne et al [eds], 2015). Similarly, faced with sea-level rise, São Tomé & Príncipe is assisting communities in low-lying coastal areas to move to safer locations nearby (Koskinen-Lewis et al, 2016). Confronted with thawing permafrost and loss of sea ice, the Alaskan village of Newtok is poised to begin relocation to a nearby site (Bronen, 2011).

While in most cases relocation of this kind will be internal, international relocation may become the only option for a number of low-lying island states, in the face of sea-level rise.

There is also a significant risk that climate change mitigation and adaptation policies could result in the need for planned relocation within countries (Mcdowell, 2011; Foresight, 2011). Land-use conversion for diverse projects related to climate-change policies (such as hydropower projects, land conversion for biofuel crops, reforestation) is planned on a large scale in some countries, with potential implications for rural populations (Mcdowell, 2011). Relocation of communities as a result of large-scale development

[36] For example, in a smallholder community facing severe environmental degradation, some households may be able to maintain viable livelihoods longer than others, due to differences between households in terms of capital (labour available, machinery possessed etc.).

[37] Determining the actual point at which land becomes uninhabitable may be contentious, subject to differing definitions and appreciations. For example, governments and affected communities may not share the same appreciation of the viability of maintaining livelihoods at differing stages of land degradation/soil fertility.

projects (including hydropower projects) has already been documented in a number of countries (De Wet [ed], 2005).

7.3.4 Disaster-induced displacement

Most studies find that the majority of disaster-induced displacement is temporary, with people seeking to return (Brzoska and Fröhlich 2015; Black and others 2011; Kälin, 2010; Surkhe and Hazarika, 1993; Belcher and Bates, 1983). They generally return more quickly than those displaced by conflict (Ferris, 2008; CRG, 2006). However, where disasters leave lasting damage, there is more likelihood that displacement can be followed by migration. There is evidence that in such cases, temporary migration increases and can lead subsequently to permanent, autonomous out-migration (Osterling, 1979) or planned relocation (Myers, Slack and Singelmann, 2008, cited in Naik, 2009). In the case of the Fukushima nuclear disaster – following the destruction of nuclear reactors by a tsunami and the evacuation of at least 150,000 people – the environmental impact (irradiation) was so severe that in many of the evacuated zones return is not likely to be possible for many years to come. Following decontamination works, the authorities attempted in 2014 to encourage residents of less affected zones to return, but surveys indicated many were unsure about or opposed to return (for more details see Ionesco et al, 2017: 24-25 and 54-55; Hasegawa, 2015).

The multi-agency Inter-Agency Standing Committee (IASC), which coordinates international policy and operational response to disasters, defines three types of durable solution for displaced people: return, local integration, and relocation. For the IASC, displacement has only ended once a durable solution has been found, meaning the person "no longer has any assistance or protection needs related to his/her displacement" (IASC, 2010). Where durable solutions are lacking, the duration of displacement can be lengthy ("protracted displacement"[38]). IDMC has documented cases of people forced to flee disasters living in situations of protracted displacement:

> "THERE IS ALSO EVIDENCE OF HUNDREDS OF THOUSANDS OF PEOPLE LIVING IN PROTRACTED DISPLACEMENT FOR YEARS FOLLOWING DISASTERS IN COUNTRIES AS DIFFERENT AS JAPAN IN THE CASE OF ITS 2011 EARTHQUAKE AND TSUNAMI, AND HAITI IN THE CASE OF ITS 2010 EARTHQUAKE, WHICH FURTHER INCREASES THEIR ECONOMIC IMPACT." (UNFCCC/IDMC, 2018)

7.4 Forced-voluntary

The distinction between forced and voluntary movements is blurred in many cases, (Ionesco et al, 2017; Hugo, 1996) for example in the case of 'secondary movements' of people displaced by disasters, described in the preceding section. The decision to send a household member elsewhere to find temporary work while recovery is ongoing might seem at first to indicate voluntary migration. Yet, the circumstances in which the household makes the decision have been imposed by the disaster, and the household may have no other options to maintain income during this period.

Another example concerns movements in the context of drought. Much depends on the severity of the drought but perhaps more importantly, on the existence of other viable options for a household to cope with the drought's effects on their livelihood (Schrepfer and Caterina, 2014).

In the case of slow processes of environmental degradation, it is very often difficult to determine the extent to which migration is forced or voluntary, particularly at earlier stages (Foresight, 2011; Ionesco et al, 2017: 18-9; Laczko and Aghazarm [eds], 2009). Temporary migration of a household member might be

[38] Defined as "situations where the process for finding durable solutions is stalled, and/or where IDPs are marginalised as a consequence of violations or a lack of protection of their human rights, including economic, social and cultural rights" (Brookings-Berne Project on Internal Displacement. https://www.brookings.edu/wp-content/uploads/2016/06/1028_internal_displacement_mundt.pdf)

more or less voluntary, depending on the availability of other options (Warner et al, 2012). In the case of autonomous permanent out-migration, some people may move away pre-emptively, before their livelihoods are destroyed, but can pre-emptive movement be classed as 'forced'? In the case of permanent relocation of communities, the actual moving process should always be voluntary (consent of the community for the terms of the relocation), but such programmes are generally a last resort, and are therefore hard to class as voluntary.

7.5 Vulnerability-resilience

Over the past ten years, it has been increasingly recognised among scholars that mobility as a response to environmental stressors should not be regarded as a negative outcome *per se*, with multiple studies highlighting ways in which migration is used successfully as a coping or adaptation strategy. Paradoxically, it has become clear that some of the most vulnerable to environmental change will be those who are either unable to use migration in this way, or who for diverse reasons choose not to (Foresight, 2011; Warner et al, 2012; Melde et al, 2017).

In recent years researchers have begun to map out the ways in which migration (or indeed non-migration) responses to environmental and other stressors relate to vulnerability and resilience, and how policy interventions could improve outcomes. Migration, particularly when planned and chosen, is increasingly recognised as an important climate change adaptation strategy, income diversification or risk management strategy.[39] A common example is that of the rural household which chooses to send a family member to undertake seasonal work elsewhere, thereby reducing its overall exposure to risk, and obtaining remittances which can be used to meet basic needs during times of environmental stress. There is also evidence that diaspora communities can make significant contributions in support of adaptation to environmental change in their origin communities (Scheffran, Marmer and Sow, 2012: 125). Several studies have shown that remittances are often a vital source of funding when disasters strike, as they arrive much faster than other forms of financial support such as public assistance (Versluis, 2014; IOM Guatemala, 2008; Le De et al, 2015; World Bank, 2014).

However, it should also be recognised that migration is not generally the preferred option, and that migration as a response to environmental stressors can also have negative dimensions. As described in section 5. Theoretical approaches, some scholars denounce what they see as an uncritical importing of the neoliberal migration and development discourse to bolster the 'migration as adaptation' thesis. They argue that the same criticisms which have been made of the migration and development discourse should also be applied to environmental migration. For example, with regard to the classic example of remittance-sending by a household member, the vulnerable conditions in which many such migrants find themselves at destination, or the additional strain imposed on those who stay behind ('brain drain', 'lost labour'), are often not considered (Schade et al. in Mcleman, Schade and Faist, 2016).

Equally, the 'social cost' of migration – the impact of physical separation of families - is rarely taken into account in this context (Melde et al, 2017; Warner et al, 2012). Such impacts can be gendered, as in the case where migration by the male head of household leads to increased risks of harassment and abuse for female household members left behind (Melde et al, 2017; Warner et al, 2012). There is evidence that in some cultural contexts, migration by the male head of household can lead to increased likelihood of child marriage for girls (IOM and Save the Children, 2017).

In addition, there is some evidence that remittances can lead to increased inequality within communities, between households receiving remittances and households with no migrant, although evidence is conflicting and much depends on the context in the receiving area (Taylor, 2005). In some cases,

[39] See for example the final report of the multi-country MECLEP research study: Making Mobility Work for Adaptation to Environmental Changes (IOM, Geneva, 2017).

communities can become dependent on remittances, which presents new risks and challenges (Cascone et al, in Milan et al [eds], 2016). In a major multi-country study exploring the links between rainfall variability, food security and migration, Warner et al (2012) for example identified four different household profiles, with some experiencing migration as a positive and some as a negative, thereby demonstrating the complexity of migration in this context.

Findings of the Where the Rain Falls Project

Four distinct household profiles for migration as a risk management strategy

Analysis of the household survey data was used to generate four distinct household profiles in relation to their migration in response to rainfall variability and food and livelihood insecurity:

1) *Households that use migration to improve their resilience (successful migration)*

Relatively food secure households with access to a wider range of adaptation options, formal and informal institutions and networks – send young single migrants who send remittances which are used to improve their resilience, such as investing in education, health, and climate-resilient livelihood opportunities and risk diversification. In these households, one or more members migrate as one of a variety of adaptation strategies, moving seasonally or temporally, often to non-agricultural jobs in cities or internationally.

2) Households that use migration to survive, but not flourish

Food insecure and land-scarce households with fewer adaptation and livelihood diversification options and lower social capital and access to institutions –migrate to survive, but not flourish. The heads of these households move seasonally in their countries to find work – often as agricultural labour in other rural areas.

3) Households that use migration as a last resort and erosive coping strategy

Households with a sparse range of choices around livelihoods, often landless and food insecure – migrate as a matter of human security in what can be seen as an "erosive coping strategy."[40] Heads of household from this group often move during the hunger season to other rural areas in their regions in search of food, or work to buy food for their families.

4) Households that cannot use migration and are struggling to survive in their areas of origin

These appear to be « Trapped populations » that struggle to survive in their areas of origin and cannot easily migrate to adapt to the negative impacts of rainfall stressors.

Source: Warner et al (2012:20)

The issue of "trapped" or "immobile" populations came to the fore following the prominence accorded to this dimension of environmental change impacts by the UK's Foresight study in 2011, building on work undertaken in 'mainstream' migration studies. This has resulted in increased attention among environmental migration scholars, and the emergence of a conceptual framing of the issue. A key distinction is made between those who are unable to migrate (involuntarily immobile, or "trapped populations") and those who choose not to move (voluntarily immobile).This approach has been refined

[40] Defined in the project final report as "one that that makes [households] more vulnerable or unable to escape poverty." (Warner et al., 2012: 99)

further by Zickgraf (2018), based on capacity to migrate, need to migrate, and desire ("aspiration") to migrate.

People may be unable to move for a variety of reasons (Foresight, 2011; Melde et al, 2017; Milan and Ruano, 2014; Adams, 2016; Zickgraf in McLeman and Gemenne [eds], 2018). Often, they lack the financial resources, network or knowledge and skills to do so. However, they may also be unable to sell their assets (for permanent migration), they may be unable to move children out of school, they may have to take care of an elderly relative: the possibilities are multiple. Equally, a wide range of factors may explain why people choose to stay (and suffer severe environmental impacts as a result). For example, they may not understand the severity or irreversibility of the risk (Ziegler, 2018). Strong attachment to place, fear of the unknown or family obligations are other potential reasons why people may not move. In some cases, the decision to stay might not be experienced as a choice, for example if the cultural attachment to place is so strong that the person does not see moving as an option (ties to ancestral lands in some indigenous cultures for example). Either way, whether it is voluntary or involuntary, immobility needs to be factored into policymaking. However, researchers have found it can be very challenging to identify these categories of immobile people (Melde et al, 2017).

Environment, human mobility and gender

Women and men are often affected by environmental stressors in different ways. Climate change exacerbates existing inequalities faced by women (Chindarkar, 2012), but it is important to avoid approaching the issue through a lens which translates "gender" as "women". In some contexts, the vulnerabilities of men can be increased by migration, as will be discussed below. Furthermore, "Gender needs to be seen in conjunction with other social identity markers, such as social class, age (…)" (Gioli and Milan, 2018).

1. Gender and natural hazard-induced disasters

Several studies have found fatality and injury rates to be higher among women in disaster situations (Frankenberg et al, 2011; Paul, 2010; Cannon, 2002; Ikeda, 1995). In a study of disaster impacts in Bangladesh, Aguilar (2004) found that women accounted for 90% of flood-related deaths. Women were far more likely to suffer severe impacts than men, for a number of reasons linked primarily to cultural differences and gendered power relations (Ikeda, 1995). These included: cultural restrictions on swimming lessons for women, low access to information on disaster warnings and evacuation plans (low literacy levels, low access to information generally) and culturally assigned role as caregivers (more likely to be trying to assist the evacuation of children and elderly family members). Another study on Bangladesh (Nelson et al., 2002) supports these findings.

Women are also more likely to be exposed to risks of gender-based violence in post-disaster situations (Anastario, Shehab, and Lawry, 2009; Felten-Biermann, 2006). There is also evidence that women can be more vulnerable to human trafficking in post-disaster situations, such as after the Nepal earthquake in 2015 (Gyawali et al, 2016). Men can also be vulnerable in disaster situations – there is evidence that masculine gender norms drive higher risk-taking behavior among men, such as during attempts to rescue survivors, as was observed during Hurricane Mitch in 1998 (Bradshaw, 2004; West and Orr, 2007).

2. Gender and migration in the context of environmental change

Migration of a household member is a common coping or adaptation strategy in areas subject to environmental stress (Foresight, 2011; Warner et al, 2012). Gender norms and dynamics of employment markets influence whether such migration is more likely to be undertaken by men or women.[41] While it is important to "avoid reducing women to the stereotype of passive victims" (Ionesco et al, 2017), migration of a male head of household – common in some regions – can have specific negative effects for female household members left behind. In Bangladesh, it can result in increased workload (especially in rural areas) risk of harassment and abuse (Warner et al, 2012), and early marriage of girls (IOM and Save the Children, 2017). A study in the Chiapas region of Mexico found similarly that male migration as a response to decreasing household income (linked to environmental changes) resulted in increased vulnerabilities for women (Jungehülsing, 2010). Men can also experience vulnerabilities in this scenario, linked to difficult living and working conditions in destination areas, and effects of family separation.

Some studies have found that male head-of-household migration leads to increased decision-making power for women who become de facto heads of household (Griener and Sakdapolrak, 2013) but in a study of Pakistan and Bangladesh, Chant (1998) found that in such contexts "women may not be able to take major decisions over household production or livelihoods in the home village itself without first obtaining permission from their absent partners or his natal kin"(Chant, 1998).

Recommended further reading:

Gioli, G and Milan, A (2018) 'Gender, migration and (global) environmental change.' In Gemenne and Mcleman [eds] Routledge Handbook of Environmental Displacement and Migration. Routledge. 135-150.

IOM (2014b) IOM Outlook on Migration, Environment and Climate Change. 'Brief 13: A Gender Approach to Environmental Migration'. IOM, Geneva.

7.6 Conflict linkages

As described in the section on "Securitisation of environmental migration" above, there has been a high level of interest among policymakers on the linkages between climate change, migration and conflict, but the evidence paints a mixed picture (Brzoska and Fröhlich, 2016; Warnecke et al, 2010). Linear analyses making direct causal linkages can be seen as having descended from conflict scholars such as Thomas Homer-Dixon (1994; 1999), who applied statistical analysis of macro-level data for large geographical areas to infer causal links between environmental factors[42], migration and conflict. In such studies, out-migration from areas experiencing resource scarcity (and potentially also scarcity-related conflicts) supposedly leads to tensions and conflict in receiving communities.

Drawing on this approach, there have been several attempts to investigate the potential for climate change to cause conflict through migration as a "transmission mechanism", since it is assumed that climate change will contribute to resource scarcity - such as through effects on crop yields - which will in turn result in increased conflict and out-migration. Prominent recent examples include studies of the Darfur conflict (Christian Aid, 2007; Brown, 2007), and the Syria conflict (Gleick, 2014; Kelley, 2015).

[41] Nearly 50% of international migrants were women in 2015, according to recent UN data (UN 2015).

[42] Often using proxies for resource scarcity, such as temperature or rainfall data.

However, the potential for conflict is determined by a range of contextual factors, and in-migration by itself is rarely found to be a direct cause of conflict (Kita and Raleigh in Mcleman and Gemenne [eds], 2018; Fröhlich, 2016; Warnecke et al, 2010). Most of the studies which claim to have established the climate change-migration-conflict link have focused on countries already affected by serious destabilising factors, such as pre-existing conflicts, political instability or demographic pressure, for instance (Kita and Raleigh in Gemenne and Mcleman [eds], 2018). Every conflict is the result of complex interactions between different social, political, economic, demographic and environmental factors. In view of this, climate change has been increasingly understood as exacerbating existing tensions and termed as a 'threat multiplier' or destabilising factor, rather than a direct cause of conflict (UN Secretary General, 2009). Kita and Raleigh (op. cit ibid: 362) assert that most scholars agree on this indirect causal linkage.

Out-migration from environmentally degraded areas typically takes place over long timescales (decades), incrementally,[43] meaning receiving communities would have more time to 'absorb' the new arrivals without creating major tensions. There is more potential for conflict when incoming migration involves large numbers of people arriving over short time frames, to communities ill-equipped to absorb them. The strength of governance in the receiving area can also be important, such as the existence of conflict resolution mechanisms (Warnecke et al, 2010). Reuveny (2007) emphasises the increased likelihood of conflict where two (or more) of the following are present: ethnic tensions, distrust, competition for public goods and services, and pre-existing fault lines such as competition for land and jobs.

There is a lack of evidence regarding conflict potential resulting from large-scale disaster-induced displacement. However, studies of large refugee influxes to camp settings have found evidence of conflict with local communities over access to natural resources such as timber, and environmental degradation in areas around camps (Berry, 2008). The duration of the camp's presence may be an important factor here – refugees originating from conflict areas tend to be displaced for longer than populations displaced by disasters. There is also evidence that disaster-induced displacement can elicit considerable levels of solidarity among receiving communities (see section 3.1 of the Impact analysis paper for details).

What do we know for Europe?

There is very little reliable evidence for existing environmental migration to Europe, primarily due to the lack of appropriate data and the complexity of identifying the environmental driver among other drivers (multicausal nature of most migration). A recent study found a statistical link between temperature variability and increased asylum applications to the European Union from 103 source countries (Myssirian and Schlenker, 2017), but it relies on questionable assumptions about causal linkages, cites few sources, and takes insufficient account of key variables such as governance and policies in origin and destination areas. In general, striking figures relating to large-scale environmental change processes (climate change, desertification for instance) are relayed by the media, accompanied by more or less implicit messages relating to the likely knock-on effects for migration to Europe, but rarely with any scientific basis for the latter.

But to dismiss the topic's relevance for Europe in view of the uncertainties relating to environmental migration to Europe, would be to fail to acknowledge the increasing threats posed by environmental change processes within Europe itself, and the potential for future migration and displacement (Jäger et al, 2009). As just one indicator of the potential severity of environmental impacts in Europe, 70,000 people died across the continent in 2003 as a result of a heat wave.44 Some southern European countries are already facing desertification in arid areas

[43] Examples include the « Dust Bowl » migration out of the American mid-West in the 1930s, or the gradual out-migration of communities dependent for livelihoods on the shrinking Aral Sea (Foresight, 2011).

[44] www.brookings.edu/blog/planetpolicy/2014/06/09/disasters-and-displacement-what-we-know-what-we-dont-know

(Ferminl, 2009), and 13,000 people were displaced by wildfires in Spain in 2012 (Ionesco et al, 2017:45).

IDMC's figures for 2017 show that natural hazards had displaced approximately 66,000 people in Europe. Although this represents only 0.4% of total new disaster displacement at the global scale, the impacts for affected communities are nonetheless significant. For example, a wildfire on the French island of Corsica resulted in the displacement of an estimated 10,000 people, making it the largest disaster-displacement event in Europe in 2017.

Climate change is likely to impact on Europe in the form of more frequent extremes of temperature (heatwaves) and precipitation, wildfires, retreat of glaciers and changes to ecosystems. More frequent winter floods, endangered ecosystems, and ground destabilisation are predicted for northern Europe, while the Mediterranean and southern Europe are expected to see increased stress on water supply, lower crop yields and a higher risk of wildfires. Central and eastern Europe is expected to experience decreased precipitation in summer months is expected to result in reduced water supply and higher risk of fire in peatland areas (IPCC, 2014).

Some European countries will also have to address challenges relating to sea-level rise. While The Netherlands has a long history (and expertise) in sea defenses, other countries may have to develop their capacities in this area. In Germany, ten inhabited small low-lying islands in the North Sea (Northfrisian Halligen Islands in the Wadden Sea) are already battling increased threats from storm-surge linked to sea-level rise and are engaged in active sea defense measures. The islands are regularly inundated and face complete disappearance without intervention (Wöffler et al, 2012).

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A Appendix: Evaluation Matrix

As part of the literature review undertaken in the framework of the project "Environmental degradation, climate change and migration: Global review of research and forecasts", a matrix was developed to organise and evaluate key findings on the migration-environment nexus. For details of how these findings were selected, please refer to section 2 of the literature review 'Methodology of the review'. The matrix below is organised in six sections:

CONTENTS

A. General findings 61
B. Prognoses 63
C. Impact Types 68
1) Mobility and sudden-onset disasters 68
2) Mobility in the context of slow-onset environmental phenomena 74
3) Linkages between environmental change, conflict and mobility 81
4) Immobile populations 83

To make the matrix easier to use and more visually appealing, the first column focuses on a key finding, while the second column provides key related sources. Subsequent columns look at the explanatory model, criticisms/reliability, and implications for policy.[45] The assessment of reliability is based on the following criteria: is the finding backed up by multiple studies or just one? Is it backed up by quantitative and qualitative studies/methods or just one type? This enables an evaluation of existing data sources and their limitations.

Note: Section B. 'Existing prognoses' focuses on quantified projections of future numbers of environmental migrants. Due to the methodological difficulties associated with making such projections, they are not numerous in the literature, hence the non-exhaustive geographical coverage. For instance, Feng's country-specific projection of environmental migration from Mexico to the US is included. The objective for this section was not to provide an accurate global projection of our own, but rather to highlight the methodological challenges involved and the weak reliability or limitations of such figures.

[45] Policy implications and recommendations will be the focus of a separate paper, undertaken within the framework of this project.

A.1 General findings

Key finding	Source(s)	Explanatory model	Criticism and assessment of reliability	Policy implications
Migration is a multi-causal phenomenon, and it is therefore often difficult to identify the extent to which movements are driven by environmental factors.	Foresight (2011)	Migration decisions (often taken at the level of the household, but also at the level of the individual) are shaped by macro-level 'drivers' (demographic, economic, , environmental, political and social, intervening factors (facilitators or obstacles) and micro-level aspects (household composition, age, gender for instance). These relate to both origin and potential destination areas.	This conception is widely accepted. While there are cases where the environmental factor is clearly the compelling factor, such as when people are displaced by a sudden-onset disaster ('flight' for survival), there are always multiple factors at play which influence the type of movement (and whether moving is an option. 'Immobility' is considered in the final section of this matrix). It is often very difficult to identify the extent to which the environment is a driver for the migration decision. Furthermore, migrants do not generally identify as environmental migrants even when environmental factors have been important in migration decisions. For these reasons, some scholars argue that rather than looking at environmental migrants as a separate category, it is important to look at migration in the context of global environmental change – this was the position adopted in the UK's influential Foresight study for instance (2011). Reliability: high	Policies designed to address environmental migration need to take account of the complex framework of elements which shape migration decisions and flows, at macro-, meso- and micro-levels. In many cases, policies will need to address human mobility in general, due to the multi-causal nature of most movements.
Environmental change is expected to impact on human mobility via its	Foresight (2011) IOM (2007), Renaud et al. (2010)	With climate change and increasing environmental degradation, the environment is becoming an ever more important driver of migration. Impacts are often indirect. This	Reliability: high	

effects on the different drivers of migration. This will mean more migration (including disaster displacement) but also more people who are unable to move ('trapped populations').		is because environmental factors are often interwoven with other factors, notably economic (such as through the economic effects of temperature or rainfall variability on crop yields).		
Temporary/seasonal/circular labour migration of one or more household member(s) is used by some households as a risk management strategy to reduce exposure and vulnerability to environmental stressors (sudden- or slow-onset).	Multiple studies in multiple regions. Examples: EACH-FOR Where the Rain Falls Foresight MECLEP Haiti case study	Physical exposure is reduced as long as the migrant is located in a lower-risk area. Vulnerability is reduced as livelihood is diversified, remittances serve as alternative to insurance, spiking in response to disaster events. Particularly observed in rural areas of developing countries exposed to land degradation and/or recurrent hazards.	Potential conditions of hardship at destination area can result in increased vulnerability. Social costs of migration (family separation). Reliability: high	Policies which facilitate internal labour mobility can help households in affected areas to benefit from migration
Environmental migration – like migration in general – is a strongly gendered phenomenon	Gioli and Milan in Gemenne and Mcleman (2018) Felten-Biermann (2006) Anastario, Shehab, and Lawry (2009)	Women's mobility is often constrained by cultural norms, and women can be subject to specific vulnerabilities during and after displacement (disasters) or migration.	Research is relatively scarce on the links between environment, gender and mobility. Reliability: high	Disaster risk reduction (DRR) policies must ensure the collection, analysis and application of sex-disaggregated data, taking account of the specific vulnerabilities of women (and men).

A.2 Prognoses

Key finding	Source(s)	Explanatory model	Criticism and assessment of reliability	Policy implications
DISPLACEMENT CAUSED BY SUDDEN-ONSET DISASTERS				
Average annual displacement risk[46] is increasing (ranging from 2.4%-3.7%) in the four regions studied: South-East Asia, South Asia, Latin America & Caribbean, South Pacific. Over the next ten years (from date of study), in South-East Asia alone 30 million people per year will be at risk of displacement.	Ginnetti (2015, for IDMC).	These projections assume a 'business as usual' scenario in which natural hazards occur with the same frequency and intensity as in the past and population growth and changes in exposure and vulnerability occur at current rates. Population growth (internal growth and net in-migration linked to internal, rural-urban migration) in highly exposed areas is a key driver of displacement risk (notably low-lying coastal zones in South and South-East Asia). Risk is measured using probabilistic risk assessment method.	Climate change is expected to increase the frequency and intensity of this type of hazard. Their figures may therefore constitute an under-estimate. Not possible to equate risk of displacement with actual displacement, many uncertainties at play, such as future levels of disaster risk reduction (DRR), population growth rates etc. Rising displacement levels may reflect better disaster preparedness (fewer casualties, but more – displaced survivors). The data do not capture patterns or duration of displacement, which are important for policy development. Reliability: medium	Need to invest in disaster risk reduction (DRR), particularly in urban areas with growing exposure linked to population growth. Urban planning policies also need to address displacement risk. Scale of the problem can mean significant impacts on development levels in more vulnerable countries. Need to integrate DRR within national development plans and programmes.
MIGRATION RELATED TO SLOW-ONSET PHENOMENA				
200 million 'environmental refugees' by 2050	Myers (1997 and 2002)	Based on population projections, 200 million people would be forced to leave 'at risk' areas by 2050 (environmental degradation, global warming impacts). Recognises that other factors	Overly deterministic – assumes all people in affected areas will move, but for various reasons many people do not move (perceive the risk as not high; lack the necessary resources; strong	Scale of projected at-risk populations warrants action, even if the projected number of environmental

[46] Displacement risk can be expressed as a function of hazard, exposure and vulnerability. This same trio composes disaster risk more broadly – displacement risk is but one type of disaster impact.

Key finding	Source(s)	Explanatory model	Criticism and assessment of reliability	Policy implications
		are interwoven, such as poverty, conflict, demographic pressure.	attachment to place e.g. ancestral land). Does not take into account future actions to prevent forced migration related to these factors. Does not distinguish between internal and international movements. Reliability: low	migrants is unreliable.
The populations living in urban floodplains in Asia may rise from 30 million in 2000 to between 83 and 91 million in 2030, and then to 119–188 million in 2060 according to different scenarios of the future.	Foresight (2011) final project report (drawing on Modelling Review 9, a Foresight-commissioned paper by Vafeidis et al, 2011).	Population growth (driven partly by rural-urban migration) in urban (or rural) floodplains will lead to increased exposure of people to sea-level rise and other climate change impacts, and potentially might result in increased migration out of these zones/trapped populations/ displacement. Many of these people live in developing countries, and combine vulnerabilities at different levels with low adaptive capacities. The scenarios are based on different configurations of economic growth (low-high), governance (inclusive or unequal), and climate change, among others.	Does not provide figures for projected migration or displacement, only for populations 'at risk'. Reliability: high	Scale of projected at-risk populations warrants action. Risk of 'trapped populations' (also in rural floodplains). Appropriate policies (per scenario) can be developed to plan for and reduce future migration influenced by environmental change, and to harness the opportunities of migration as an adaption response. See Foresight (2011) chapters 6-8.
By 2050 (under the pessimistic scenario) —in just three regions: Sub-Saharan Africa, South Asia, and Latin America—	Groundswell report (World Bank, 2018), - Key findings section and for Bangladesh figure: p127	Uses the 'gravity model of migration', which is based on the assumption that as the 'importance' of locations increases, so does the amount of migratory movement between them. Importance can be defined in different ways. In this study, demographic, socioeconomic, and climate	The scope of internal migration definition is limited: "The modelling work captures people who move at spatial scales of over 14 kilometres - within a country - and at decadal temporal scales. Shorter distance or shorter-term mobility (such as seasonal or cyclical	Scale of predicted movements warrants action in many of the countries studied. Appropriate policies can be developed to plan

Key finding	Source(s)	Explanatory model	Criticism and assessment of reliability	Policy implications
climate change could force more than 143 million people —or around 2.8 percent of the population of these three regions—to move ***within their countries*** to escape the slow-onset impacts of climate change (unless concerted action is taken at the national and global levels.) For Bangladesh, average projection of 13.3 million internal climate migrants by 2050 under pessimistic scenario.		impact data (water availability, crop yield, sea-level rise) are applied to a 14-square kilometre grid cell level to model likely shifts in population within countries. It deducts the projected movement based on a model run using constant climate impact data from the projected movement based on a model run using increasing climate impact data. To address the uncertainties of analysing migration over the next 30 years, the report considers three potential climate and development scenarios.	migration) is not captured."[47] Seasonal and cyclical migration have widely been found to be very important dimensions of environmental migration in the regions studied, so this is a significant limitation to the report's scope/validity. Gravity model approaches do not sufficiently take into account individual factors behind migration decisions. The focus on slow-onset climate impacts (water stress, crop failure, sea level rise) rather than rapid onset events such as floods and hurricanes, leads to a lower-bound estimate of the likely overall impact of climate change on migration across the three regions. New method, but scale looking at three regions. Reliability: medium	for and reduce future internal displacement caused by slow-onset climate change, and to harness the opportunities of migration as an adaption response. Could high levels of internal migration, such as predicted for Bangladesh, lead to international migration?
By approximately 2080, climate change is estimated to induce 1.4 to 6.7 million adult Mexicans (or 2% to 10% of the current population aged 15–65y) to migrate as a result of declines in agricultural	Feng et al (2010)	Statistical modelling technique (regression analysis), to isolate the environmental 'driver' from other drivers of migration and estimate the sensitivity of emigration to crop yields. The range for future out-migration figures is explained by the different warming scenarios used and adaptation levels assumed, with other factors held constant.	The study does not control for many "confounding factors" i.e. variables other than crop yield and migration, which could provide competing causal explanations. The range 1.4 to 6.7 million is so broad that it limits utility for policy purposes. The results cannot be mechanically extrapolated to other areas and time periods,	Many regions, especially developing countries, are expected to experience significant declines in agricultural yields as a result of projected warming. While the reliability of this

[47] World Bank (2018: vii)

Key finding	Source(s)	Explanatory model	Criticism and assessment of reliability	Policy implications
productivity alone.			due to the importance of context. The method implicitly assumes that the response to changes in the climate variables is linear and symmetric, and that migration responses to 5-y changes in climate conditions can be applied to longer run trends. Reliability: low	study's projection is considered low, it provides a useful 'order of magnitude'.
Holding everything else constant, asylum applications to the EU by the end of the century are predicted to increase, on average, by 28% (98,000 additional asylum applications per year) under the IPCC's representative concentration pathway (RCP) scenario 4.5 and by 188% (660,000 additional applications per year) under RCP8.5 for the 21 climate models in the NASA Earth Exchange Global Daily Downscaled	Myssirian and Schlenker (2017)	Examines how, in the recent past (2000–2014), weather variations in 103 source countries translated into asylum applications to the European Union. Moderate temperatures around 20°C minimize asylum applications. Both colder and hotter temperatures increase migration. Having identified statistical relationships between these variables, they extrapolate into the future, holding all other variables constant.	Makes questionable assumptions about causal linkages, citing few sources, and not taking sufficient account of key variables such as governance and policies in origin and destination areas. For instance, the assumption that temperature fluctuations will lead to conflict, which will lead to asylum applications. States evidence for increased flows not being economic migrants: Reliability: low	More research is needed to confirm if impacts of climate change in low income source countries will spill over into developed countries through increased migration (including refugee) flows.

Key finding	Source(s)	Explanatory model	Criticism and assessment of reliability	Policy implications
Projections (NEX-GDDP).				

A.3 Impact Types

1) MOBILITY AND SUDDEN-ONSET DISASTERS

Key finding	Source (s)	Explanatory model	Criticism and assessment of reliability	Policy implications
There is a significant risk of displacement resulting from climate change mitigation and adaptation policies.	Mcdowel, 2011 Foresigh, 2011	Land-use conversion for diverse projects related to climate-change policies (such as hydropower projects, land conversion for biofuel crops, reforestation projects (carbon sinks)) often involves relocation of people, frequently vulnerable populations in rural areas.	Scale of such displacement relatively small compared to the overall benefits ("greater good" argument). Reliability: high	Climate change mitigation and adaptation policies should ensure any resultant population displacement is minimized and relocation (where necessary) is carried out in line with international guidelines such as the UN Guiding Principles on Internal Displacement and more recent guidelines focusing specifically on relocation in the context of disasters and environmental change.
NEAR-FAR				
Most movements in response to sudden-onset disasters are internal, usually to the nearest safe location, and people are likely to return if and when possible.	Milan et al [eds.] (2016) Adamo and Izazola, (2010) Naik, in Laczko et al [eds.] (2009) Raleigh et al (2008) Hugo (1996) Zaman (1989)	Immediate response involves 'flight' to the nearest area deemed safe. Secondary movements may involve moving several kilometres to camps or to stay with friend/relatives. Post-disaster, temporary migration to nearby urban areas has been documented.	This finding is not controversial. Cross-border/international migration is more likely to occur in border areas and small states (in particular, small island developing states). Reliability: high	DRR and humanitarian response policies should take account of the diverse geographical range of disaster-related mobility. DRR measures should be implemented at local and national levels. Cross-border disaster displacement presents some specific protection challenges. Recommendations on this aspect were recently adopted by 109 governmental delegations – the "Agenda for the Protection of Cross-Border Displaced Persons in the

Key finding	Source (s)	Explanatory model	Criticism and assessment of reliability	Policy implications
		Migration movements across borders have been documented, such as after Hurricane Mitch in 1998 (Central America – USA) or after the Haiti earthquake in 2010 (Haiti – South America), but cross-border disaster displacement is not prevalent in general.		Context of Disasters and Climate Change".[48]
TEMPORARY-PERMANENT				
Disaster-induced displacement is usually temporary.	Surkhe and Hazarika (1993) Calcutta Research Group (2006) Ferris (2008)	Disaster-displaced people are generally able to return more quickly than people displaced by conflict. The duration will depend on factors such as type and intensity of the hazard, vulnerability of the affected population, and funding for recovery.	Protracted displacement can occur when durable solutions (return, local integration or relocation) are not made available. Reliability: high	Policies addressing disaster-induced displacement should aim to limit the duration of displacement and promote sustainable reintegration upon return, where possible.
Displacement can lead to subsequent temporary migration.	Ionesco et al (2017) Dang et al (2016) Pierre (2015)	Post-disaster, temporary migration is a common response (especially in the absence of adequate public	It can be difficult to identify this type of migration as environmentally driven. Reliability: high	Policies to facilitate temporary migration as a post-disaster response could support people to recover, and potentially build resilience to disasters in the longer term.

[48] www.nanseninitiative.org/global-consultations/

Key finding	Source (s)	Explanatory model	Criticism and assessment of reliability	Policy implications
	Foresight (2011) Osterling (1979)	assistance or where there is long-term damage to livelihoods). This type of migration may be a coping strategy in the recovery phase, but may also be 'used' in the longer term as a pre-emptive risk management strategy in areas subject to recurrent displacement. It may also be a livelihood diversification option when livelihoods have been durably affected by the disaster(s).		
Displacement can lead to subsequent permanent moves.	Ionesco et al (2017: 54-55) Foresight (2011) Osterling (1979)	There are some examples of pre-emptive permanent relocation programmes in zones deemed at very high risk of future displacement by sudden-onset hazards (Thailand, Mozambique). When a disaster results in severe and permanent damage (such as with major industrial accidents), it may lead to permanent autonomous out-migration, local integration at	Generally accepted finding. Reliability: high	The predicted increase in the frequency and intensity of extreme events linked to climate change may result in increased recourse to planned relocation, as cumulative impacts become severe and render livelihoods unsustainable.

Key finding	Source (s)	Explanatory model	Criticism and assessment of reliability	Policy implications
		the site of displacement, or assisted/planned relocation.		
FORCED-VOLUNTARY				
Immediate 'flight' from sudden-onset hazards is often a matter of survival, and is clearly a form of forced movement ("displacement"). However, the picture becomes more nuanced in relation to subsequent movements.	Ionesco et al (2017: 18-19) Hugo (1996 and 2009) Naik in Laczko et al [eds] (2009) Dun & Gemenne, 2008: 10.	As described above (Temporary-permanent), displacement can lead to subsequent temporary migration. Such movements occur along a forced-voluntary continuum but the available options are often constrained compared to 'normal-time' mobility. De facto evictions have been documented post-disaster (such as Haiti after the 2010 earthquake), which have resulted in situations of clearly forced secondary or protracted displacement. Similarly, forced return or relocation can occur.	Generally accepted finding. Reliability: high	Policies to facilitate temporary migration as a voluntary post-disaster response could support people to recover, and potentially build resilience to disasters in the longer term.
VULNERABILITY-RESILIENCE				

Key finding	Source (s)	Explanatory model	Criticism and assessment of reliability	Policy implications
Mobility responses to a given sudden-onset natural hazard are often heterogeneous, depending on diverse factors of resilience/vulnerability at different levels (individual, household, community).	Foresight (2011) Black et al. (2013)	Vulnerability *shapes inter alia* duration and distance of displacement, type of secondary movements, conditions at site of displacement. It also shapes immobility – from whether or not people actually choose/are able to flee a hazard, to the availability of migration as a post-disaster income option.	Generally accepted finding. Reliability: high	Addressing vulnerability is a key dimension of addressing disaster risk. It combines actions relating directly to disaster-risk (disaster preparedness for instance) and actions to improve development indicators (level of education for instance).
In some places, women are more vulnerable to natural disasters due to (often cultural) constraints on their mobility, and more likely to experience increased vulnerabilities post-disaster.	Gyawali et al (2016) Aguilar (2004) Fothergill (1996) Warner et al, (2008: 14)	Gender can be an important determinant of vulnerability both pre-, during and post-disaster. For example, there is evidence that women have become more vulnerable to human trafficking in post-disaster situations (Bangladesh, Vietnam, Nepal).	Generally accepted finding. Reliability: high	Policies to address disaster displacement need to include gender-specific analysis/provisions.
Remittances can be a key source of income for disaster relief.	Versluis (2014)[i] IOM Guatemala (2008)[ii] IOM (2015)[iii] Word Bank (2014)[iv]	Evidence from surveys (e.g. remittances arrive faster than official assistance) and macro-level data (e.g. annual data on remittances show spike in remittances from diasporas in	The poorest households – those most vulnerable to disaster impacts – are unlikely to have access to remittances. Reliability: ?	Need to take remittances into account when planning post-disaster assistance programmes and at the same time develop pro-poor policies for those not able to move.

Key finding	Source (s)	Explanatory model	Criticism and assessment of reliability	Policy implications
		years of major disasters)		
Early warning systems are often lacking, or not reaching exposed populations in time.	Melde et al (2017)	Based on household surveys in the six pilot countries of the MECLEP project.[49]	Generally accepted finding. Reliability: high	Strengthen DRR capacities (human and financial) of local authorities, such as to improve participatory development of evacuation plans and their dissemination, or the use of latest technology to disseminate information before and during disasters (mobile phone apps; internet-based media sources/tools).

[49] https://environmentalmigration.iom.int/migration-environment-and-climate-change-evidence-policy-meclep

2) MOBILITY IN THE CONTEXT OF SLOW-ONSET ENVIRONMENTAL PHENOMENA

Key finding	Source(s)	Explanatory model	Criticism and assessment of reliability	Policy implications
NEAR-FAR				
International migration represents only a small fraction of environmental migration, partly due to the significant resources required. However, cross-border migration to neighbouring countries has been documented, such as Mexico-US, within West Africa (linked to drought, land degradation), within East Africa (pastoralists), within Australasia (Pacific islands to New Zealand through temporary labour migration schemes).	Melde et al (2017) Obokata, Veronis and Mcleman (2014) IOM (2014)) Foresight (2011) Feng et al (2010) Hunter (2013) Leighton (1997) Findley (1994)	Many of the most severe impacts of environmental change are being/will be felt in developing countries, where most (potential) migrants do not have sufficient resources for international migration. Internal migration is less expensive, less risky, and facilitates the maintenance of ties with origin area. Cross-border migration – while remaining less prevalent than internal migration – can occur, and is more likely in border areas, particularly where borders are porous, and/or significant opportunities across the border act as a 'pull factor'.	There is some evidence that climate change could lead to increased international migration flows, though there is also evidence for the opposite effect. Reliability: high	Efforts to address environmental migration should focus primarily on national and local levels.
Internal environmental migration tends to be rural-rural, or rural-urban.	Warner et al (2011) Tacoli (2011)	Rural-rural migration is often seasonal, reflecting differences in agricultural seasons in different parts of a country. Rural-urban migration is an important factor in urbanisation processes (especially in Asia).	Lack of studies on migration out of urban areas due to environmental factors. Most studies focus on rural zones in developing countries, rather than impacts in urban	Anticipate (through urban planning taking internal migration into account) likely continuation of urbanisation trends in developing (and many middle-income) countries.

Key finding	Source(s)	Explanatory model	Criticism and assessment of reliability	Policy implications
			destinations (including impacts on the migrants). Reliability: high	
Social networks are a key determinant of destination.	Castles et al (2014) Foresight (2011) Tacoli (2011) Etzold and Mallick, in Milan et al [eds] 2016	Environmental migration usually follows existing migration patterns. "People's access to migration opportunities and their choice of destination reflects existing patterns of social inequality."[50] In general, poorer members of society have narrower social networks (numerically and geographically), thereby limiting opportunities for migration.	This is widely accepted, and applies to migration in general, not only to environmental migration. Reliability: high	Policies to facilitate migration as an adaptation strategy should include support for existing destination areas for migration in general.
TEMPORARY-PERMANENT				
Migration is likely to be temporary or seasonal at the earlier stages of environmental stress, with permanent out-migration becoming more likely at later stages.	Foresight (2011) Warner et al (2011) Bohra-Mishra et al (2014)	Remittances from seasonal and temporary migration can allow households suffering environmental stress to cope, but permanent migration becomes increasingly likely as impacts on livelihoods and ecosystem services become acute and potentially also irreversible.	This is a generally accepted finding. Reliability: high	Policies to support planned and well-managed migration can help some households to remain in situ for longer (in parallel with measures to build resilience/promote adaptation *in situ*).
Relocation can be an effective adaptation strategy but poses major challenges.	Ferris (2017)	Where in situ adaptation is not	There are examples of relocation which have not been	Relocation is likely to become increasingly necessary as environmental change processes such as land degradation and sea-

[50] Etzold and Mallick, in Milan et al [eds] (2016 : 118)

Key finding	Source(s)	Explanatory model	Criticism and assessment of reliability	Policy implications
	Melde et al (2017) Blocher and Gharbaoui, in Milan et al (eds) 2016 Foresight (2011)	feasible,[51] and the impacts are/will be severe, relocation can be an effective response. Relocation needs to be carried out in an inclusive way, involving the participation and consent of the community to be relocated and the destination community (where applicable). Planned relocation is already taking place in many countries around the world, but less visible than for instance disaster displacement.	successful. This may be due to failures in the process (consent, participation) or inadequate conditions at destination (notably in relation to livelihoods). Community cohesion is often negatively affected. However, the evidence on past cases of relocation is limited. Reliability: low/medium	level-rise are likely to make more areas uninhabitable, but other options should always be explored (land rehabilitation or sea-defence systems for instance), and consent obtained for the option pursued. It is important to learn from existing experiences and share those at the international level in line with the call for better understanding of it in the Cancun Adaptation Framework of the UNFCCC (14. (f), COP Decision 1/CP.16, UNFCCC, 2010).
FORCED-VOLUNTARY				
Migration in this context takes place along a continuum, ranging from clearly forced movements to planned, voluntary movements.	Warner et al (2011) Foresight (2011) Laczko and Aghazarm [eds] (2009) Hugo (1996)	Migration as a coping or risk management strategy at early stages of environmental degradation is likely to be more voluntary than when impacts are severe and permanent. The availability of alternatives to migration as a coping strategy is an indicator of more voluntary types of movement.	At what point do pre-emptive moves become forced? Measuring the degree of voluntariness is extremely challenging, if not impossible. Reliability: high	Policies should aim to ensure people exposed to environmental stress have choices in regard to coping/adaptation strategies, with migration being one but not the only option.
VULNERABILITY-RESILIENCE				
Migration – including migration of only one	Melde et al [eds.]2017),	Common example of one or more	Several studies have	"A strong enabling environment for migration needs to be in place

[51] It is hard to determine thresholds or benchmarks for when adaptation is not deemed feasible anymore. In the end it is often a question of how much States are willing to spend.

Key finding	Source(s)	Explanatory model	Criticism and assessment of reliability	Policy implications
or several household members, with the others staying behind - can be part of effective adaptation strategies. While internal remittances are underreported, evidence indicates that internal migration, like international migration, can contribute significantly to poverty reduction.	Warner et al, (2012), Foresight (2011), UNDP - HDR(2009) And cited in UNDP (2009: Ch. 4:73): Deshingkar and Akter (2009). Rayhan and Grote (2007). Beegle, De Weerdt, and Dercon (2008).	household members migrating from environmentally stressed rural zones on a temporary basis and sending remittances (rarely picked up in migration data collection). WTRF Bangladesh case study found internal remittances a 'substantial contribution' for more than half of respondents. Studies in India, Bangladesh, Tanzania, Mexico and Indonesia have found poverty rates in households with a migrant fall by as much as one half during periods studied.	investigated whether migration should be treated as adaptation or as failed adaptation (e;g. Perch Nielsen et al 2008; Tacoli 2009, Bardsley and Hugo 2010). In many cases the majority of remittances are used for basic needs ('coping') – more about moderating harm than exploiting beneficial opportunities (the two aspects of the IPCC's definition of climate change adaptation). Coping can be maladaptive in the long term. The 'social costs' of migration are often not adequately taken into account. The WTRF Bangladesh case study highlights this aspect, for example the vulnerability of female household members left behind: "adolescent girls and young women also face sexual harassment in	supported by direct incentives, such as skills training and job creation programs, for people to move to areas of low risk and greater opportunity. Strategies supporting internal migration need to safeguard not only the resilience of those moving, but also of those in sending and receiving communities." (Groundswell, xxiv)

Key finding	Source(s)	Explanatory model	Criticism and assessment of reliability	Policy implications
			the absence of male household members, leading to social stigma and even early marriage, which has long-term negative social and demographic implications." Reliability: high	
Household- and community-level impacts of remittances on vulnerability vary greatly according to local contexts.	Warner et al (2012) Melde et al (2017) Hunter and Nawrotski in White [ed] (2016) Cascone et al, in Milan et al [eds] (2016) De Haas (2007)	For example, there is conflicting evidence regarding community-level effects on agricultural intensification/land abandonment. In some cases remittances can exacerbate inequalities and lead to remittance-dependency. But households receiving remittances tend to be more resilient to environmental stressors.	Generally accepted finding. Reliability: high	Policies designed to promote remittance-sending in support of adaptation need to take account of national and local specificities to avoid potential negative unintended outcomes (particularly at the community level). This might include targeted development assistance to reduce inequalities, or create investment opportunities (for remittances) that benefit entire communities
Individual (or household) agency is an important factor in determining response to environmental stress.	Warner et al (2012) Foresight (2011) Kniveton (2009) Grothmann and Patt (2005) McLeman (2006):	Migration or non-migration decisions are not always rational in relation to an objective assessment of current impacts/future risk. Perception is one explanatory factor: perception is "very important in determining whether or not people undertake adaptive measures –	Underestimates people's capacity for rational decision-making? Few decisions are taken with perfect information. Judging the rationality of someone else's thought processes is	Efforts to improve people's understanding of key issues (risk, exposure, vulnerability, adaptation) will help to ensure adaptation policies have the desired effects. Efforts to improve understanding of household decision-making processes among policymakers and practitioners (for example, through conducting needs assessments to inform relocation policies/programmes).

Key finding	Source(s)	Explanatory model	Criticism and assessment of reliability	Policy implications
		perception of risk, perceived efficacy of adaptation, perceived cost of adaptation" (Kniveton, 2009:62). This includes decisions on whether to migrate.	fraught with difficulty, not least in relation to cultural bias. Over-emphasis on individual agency could be used as an excuse for inaction by policymakers. Reliability: high	
Temporary migration by male heads of household, a commonly observed coping strategy, can result in increased vulnerabilities for people – especially women - staying behind.	Melde et al (2017) Warner et al (2012)	This may include vulnerability to the impacts of environmental phenomena, or vulnerability of female household members left behind to harassment and abuse. Women staying behind may also suffer from an increased workload, especially in rural areas, where a woman may find herself responsible for performing work hitherto undertaken by the man in addition to her existing responsibilities.	Gender-based analyses of migration should also consider vulnerabilities for men (Demetriades and Esplen, 2008). Migration can also increase the vulnerability of men who are separated from their families and often exposed to harsh work conditions. Reliability: high	Policies to address environmental migration need to include gender-specific analysis/provisions.
People migrating from rural to urban areas may be exposed to high(er) levels of environmental risk in their destination.	Foresight (2011)	Many of the large cities, particularly in coastal areas, which draw migrants from rural areas are subject to environmental threats such as water stress, flooding, sea-level-rise. Migrants	Lack of quantified data for such movements. Internal migration is not usually a well recorded phenomenon in	Sustainability of livelihoods and disaster/environmental risks at destination must be taken into account in migration policy.

Key finding	Source(s)	Explanatory model	Criticism and assessment of reliability	Policy implications
		often settle in higher-risk parts of cities where land/accommodation is more affordable (peripheral areas subject to landslides, flooding).	migration data or censuses. Reliability: medium-high	
Translocality, whereby households (or certain members thereof) live between different localities over long timeframes, can build households' resilience to environmental change.	Porst and Sakdapolrak (2018) Milan and Ho (2013)	Translocal households spread risk through geographical 'presence' across different locations, enabled by 'circular' migration. Often, risk is spread between urban and rural areas, and support is bi-directional according to need.	A translocal focus allows researchers to look not only at migrant networks but also at a wide array of inter- and intra-household connections between people in different locations Translocal approaches to migration studies are based on a completely different understanding of place, space, and locality from mainstream migration studies, and are not fully integrated in the migration and environment literature yet. Reliability: high	Policy approaches should take a holistic approach and deal with migration as part of a range of many processes, connections and flows in and between the places of origin and the localities where migrants go.

3) LINKAGES BETWEEN ENVIRONMENTAL CHANGE, CONFLICT AND MOBILITY

Key finding	Source(s)	Explanatory model	Criticism and assessment of reliability	Policy implications
Large-scale displacement caused by natural disasters is unlikely to result in conflict in receiving areas but may lead to tensions under certain conditions.	Foresight, 2011 Warnecke et al (2010)	Disaster-induced displacement is usually of limited duration, with people seeking to return quickly once conditions allow. Where disasters result in the protracted displacement of large numbers of people – whether in camp settings or not - there is potential for tensions with local communities, particularly where the influx modifies existing socio-economic, environmental or cultural balances.	There is a lack of evidence on disaster displacement effects on conflict in receiving areas – much of the evidence relates to the effects of conflict-induced displacement, which presents a distinct set of additional challenges. Reliability: medium	Implement relevant guidelines for camp operations and closure,[52] to reduce the ecological footprint of camps and engage with receiving communities. Implement effective DRR policies to reduce the potential for disaster displacement. Support the speedy identification of durable solutions for people displaced by disasters, prioritising (where feasible) sustainable return.
Out-migration linked to environmental change in rural areas is unlikely to be a direct cause of conflict in receiving (urban) areas, but may exacerbate existing tensions.	Kita and Raleigh, in Mcleman and Gemenne [eds], 2018 Fröhlich (2016) Kelley (2015) Foresight (2011) Warnecke et al (2010)	Autonomous out-migration from environmentally degraded areas typically takes place over long timescales (decades), incrementally, meaning the impact on receiving communities can usually be absorbed without causing tensions. This may not be the case once certain 'tipping points' are reached. Potential for conflict is greater when	Conflicting evidence as regards labour market impacts of migration in receiving areas, with some studies finding downward pressure on wages, some finding none (Rigaud et al, 2018:35) Reliability: medium	Policies to help destination areas absorb in-migration (urban planning and infrastructure development in urban destinations, that benefits both migrants and host communities).

[52] See for example The Camp Management Toolkit developed by the Norwegian Refugee Council (NRC) and The Camp Management Project (CMP). Available at : http://postconflict.unep.ch/humanitarianaction/documents/02_02-05.pdf

Key finding	Source(s)	Explanatory model	Criticism and assessment of reliability	Policy implications
		incoming migration involves large numbers of people arriving over short time frames, to communities ill-equipped to absorb them (in particular communities affected by pre-existing conflicts).		
Climate change impacts can increase the risk of conflict among pastoralist groups, and between pastoralist groups and sedentary farming communities.	UNEP et al, (2011) IOM (2010) UN Office for the Coordination of Humanitarian Affairs (UN-OCHA) et al.(2010)		Evidence limited to Sahel region in Africa. Reliability: medium	Support the peaceful mobility of pastoralists, such as transhumance agreements to facilitate the cross-border movement of livestock.

4) IMMOBILE POPULATIONS

Key finding	Source(s)	Explanatory model	Criticism and assessment of reliability	Policy implications
Many people do not move away from areas exposed to environmental stressors.	Zickgraf in Mcleman and Gemenne (2018) Melde et al (2017) Adams (2016) Nawrotski in White [ed] (2016) Foresight (2011) Dun (2011) Hunter and	Non-migration in the face of environmental stressors (slow- or sudden-onset) can be the result of choosing to stay (immobile), or being unable to leave (trapped). People may choose to stay for a wide variety of reasons. These include human perceptions of risks and opportunities, or the strength of social or spiritual ties to home (e.g. ancestral ties to land). People may be unable to leave (trapped) if they lack the requisite 'capital' e.g. financial, social (networks in potential destinations), human (skills, knowledge needed for migration), physical (state of health).	Immobility is often very difficult to measure, and currently available data is primarily based on qualitative research studies and small-scale surveys. Reliability: medium	Immobile populations can be among the most vulnerable to the impacts of environmental stress, especially those who are unable to move ('trapped populations'). Climate/environmental change is likely to increase the prevalence of 'trapped' populations, through erosion of livelihoods (falling crop yields for instance) resulting in depletion of capital needed for migration. Policy interventions can help trapped populations to move (facilitating migration, planned relocation etc). Public policies which increase resilience generally will help to address this challenge (social safety nets, DRR measures).
Existence of a 'sedentary bias' within certain development policy circles, which sees migration out of rural areas in developing countries as inherently negative.	Bakewell (2007)	This approach, with its roots in colonial practice and paternalistic views of preserving 'sedentary tribal traditions', views migration as a negative	Fails to take account of widespread historical mobility both prior to and during the colonial period, and fails to grasp the potential	Can lead to lack of funding/policies to facilitate access to migration as one potentially effective adaptation strategy, and increased risk of 'trapped populations'.

Key finding	Source(s)	Explanatory model	Criticism and assessment of reliability	Policy implications
		phenomenon, to be minimised to the extent possible through rural development. In its more recent incarnation, it is linked to the fear of unplanned in-migration "overwhelming the embryonic urban structures" already struggling to manage rapid population growth.	positive impacts of migration. Reliability: medium	

[i] Versluis, A. 2008. Formal and informal material aid following the 2010 Haiti earthquake as reported by camp dwellers. *Disasters*. Vol 38, Issue s1, S94-S109. A 2014, Wiley.

[ii] IOM Guatemala, 2008. Survey on Remittances 2008 and Environment, *Working Notebooks on Migration*, No. 26; 2008

[iii] Le De, L. et al. 2015. Remittances and disaster: Policy implications for disaster risk management. *IOM Policy Brief Series: Migration, Environment and Climate Change*, 1(2).

[iv] World Bank, 2014. Migration and remittances: Recent development and outlook (Special topic: Forced migration). *Migration and Development Brief* 23, 6 October 2014.