Climate Change and Migration Readiness, Willingness, and Ability

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Abstract

In media reports and public debates, climate change has often been depicted as a major reason for expecting massively increasing migration flows. In the future, more and more people would be on the run from extreme weather events, looking for new places to live as a growing share of their current habitats turn uninhabitable. As such, climate-driven migration would add to already ongoing flows due to global socioeconomic inequality. However, according to recent scholarly literature, such claims are based on speculation rather than based on solid scientific reasoning and evidence. This paper aims to review both the theoretical reasons and empirical evidence gathered so far about climate-induced migration. Factors that have emerged from the literature are organized in a theoretical framework that links social, economic, cultural and political drivers of migration readiness, willingness and ability in response to slow and fast onset climate events. From a theoretical perspective, it turns out not to be so clear that climate change must lead to more people being on the run, as some of the drivers have diverging and sometimes opposite effects on readiness, willingness or ability. The paper concludes with an outlook for the uncertain future impacts of climate change on migration flows.

1. Introduction

In the coming decades, the world population will be exposed to the impacts of the ongoing climate change, including further increases in global average temperature, changes in precipitation patterns, rising sea levels and more frequently happening extreme weather events such as droughts, heat waves, and floods (IPCC 2018; Jones & O'Neill 2016). For example, Kulp and Strauss (2019) estimate that the number of people annually exposed to coastal flooding, under constant population, could increase from 250 million people around the year 2020 to between 310 and 420 million or up to between 380 and 630 millions. Such events and processes will affect (drinking) water supply, agricultural production and crop yields, health and economic growth. Such effects will be much stronger in some parts of the world than in others (IPCC 2014; 2018).

One response is to adapt to such changing environment by migration to another region. In both recent and distant history, many examples can be found of people moving out of one region to another because of adverse climatic conditions (Hunter et al. 2015: 385; Cattaneo et al. 2019: 189; Niva et al. 2021). Already in 1992, the International Organization for Migration stated that climate change leading to environmental degradation would result in

large migration flows and expected it to increase substantially as a result of further climate change (IMO 1992; see also Westing 1992).

In early scholarly work, in policy documents and in media reports, the stereotypical view has been painted that environmental change would induce mass-migration more specifically from the Global South to the North (Boas et al. 2019). In media reports, climate change is being depicted as almost inevitably leading to mass migration, with grand reports on the start of "The Great Climate Migration" (*New York Times* 23 July 2020)[1], "Climate change already fueling global migration"[2], and titles such as "The century of climate migration: why we need to plan for the great upheaval" (*The Guardian* 18 August 2022).[3] In such media reports as well as in recent political and policy debates, migration induced by climate change is typically framed as a problem (Hartman 2010), and more specifically as a concern in rich countries that "[m]illions of people, largely in Africa and Asia, might be forced to leave their homes to seek refuge in other places or countries" (Biermann & Boas 2010: 60).

As argued by Boas et al. (2019), both in media reports and in funding schemes for research, there has been an emphasis on the potential security threat that climate-induced mass migration from the Global South could pose to the Global North, including an emphasis on calls for research that could find a way to avoid harm in destination counties of the North and finding ways to keep potential migrants in their places of origin. The narrative about climate-induced migration has become one of the rationales in the Global North to strengthen its external borders (Boas et al. 2019: 902), much in line with the increased emphasis on closed border politics that has emerged in many Western countries (Van Bavel 2020). Consistent with this is the remarkable geographic asymmetry in studies on climate change: the majority of studies are about developing countries and emerging economies, but by researchers from high-income countries (Piguet at al. 2018). A particular research focus is placed on a number of countries in South Asia, Western and Eastern Africa, Latin America and the Caribbean (Hoffmann et al. 2021, Figure 2).

Nevertheless, the more recent scholarly literature has moved away from simple, linear environmental push-theories of climate migration (Hunter et al. 2015). Recent scientific studies no longer extrapolate large international migration flows as an almost inevitable effect of the ongoing and expected climate change. Rather, research carried out so far has made it clear that migration is usually not driven by climatic conditions as such but rather by a mix of climatic, socio-economic, cultural and political factors (Boas et al. 2019; Hermans & McLeman 2021).

This paper aims to review recent scholarly work on climate migration, meaning migration that is at least partially motivated by the implications of climate change. First, I discuss why and how the field has moved away from simple push-pull models and what new concepts have emerged. These concepts have become well-established and are now being used to

[1] https://www.nytimes.com/interactive/2020/07/23/magazine/climate-migration.html

[2] https://www.pbs.org/newshour/world/climate-change-is-already-fueling-global-migration-the-world-isnt-ready-to-meet-peoples-needs-experts-say

[3] https://www.theguardian.com/news/2022/aug/18/century-climate-crisis-migration-why-we-need-plan-great-upheaval

conduct more nuanced empirical analyses on the complex relationships between climatic conditions and human mobility. There is no unified theoretical approach yet that represents how climate change will affect migration flows (Cattaneo et al. 2019: 190; Black et al. 2011a) but, nevertheless, a lot has been learned from recent empirical studies on climate-related migration. Therefore, I introduce a theoretical framework that implies that migration will only happen when people are ready, willing and able to do so. Next, I discuss drivers and factors behind migration readiness, willingness and ability that have appeared as relevant in earlier research. After that, I argue that the concept of habitability needs to be introduced and developed in the social sciences, and in social demography in particular, and that immobility in extreme weather conditions needs just as much explanation as mobility (as illustrated by the concept of trapped populations). I conclude with discussing the outlook for the future.

2. First generation of research: climate change as a push factor

Just as the influence of the ecological environment and environmental change has been largely absent in social scientific theories of migration (Black et al. 2011a), so much has established social scientific theorizing been absent in early research about the impact of climate change on migration flows. A first generation of research about climate migration got going in the 1990s (Westing 1992; Myers 2002) and was dominated by geographers and environmental scientists focusing on livelihood vulnerability to climate change. Such vulnerability was then considered as a push factor for migration away from deteriorating environmental conditions (Hunter et al. 2015).

Initially, studies were based on linear, gravity-based theoretical reasoning on climate migration and produced bold but rather simplistic projections of the number of "climate refugees" – projecting up to around 50 million climate migrants by 2010 (Westing 1992; Myers 2002; Biermann & Boas 2010), rising to about approximately 200 million by 2050 according to projections by Myers (2002). The underlying theoretical models boiled down to the simple "common sense" reasoning that people will move away from areas that become inhabitable due to worsening climatic conditions; people who live in areas that experience adverse consequences of climate change, such as land degradation, extreme precipitation, storms, flooding, rising sea level, may be pushed, if not forced, to migrate. The models were linear in that more environmental stress in more vulnerable regions would imply more outmigration, with the rate of migration proportional to the degree of environmental stress. And they were gravity-based in that the projected number of migrants between two regions would be proportional to the sizes of their populations and inversely proportional to the distance between them.

There appeared to be a number of interrelated problems with this first generation of research and projections. First, the empirical evidence in support appeared to remain very meagre (Black et al. 2011a; Boas et al. 2019; Niva et al. 2021; Zickgraf 2021). After the 1990s, a large number of empirical studies had been conducted on climate change and migration. Some of these studies found that environmental change contributes to increased migration while no effect or even a decline in migration was found in other studies (Hoffmann et al. 2020). Second, the underlying assertions were indeed just based on rather simplistic "common sense" rather than on established scientific theory (Black et al. 2011a; Hunter et al. 2015). More and more studies documented that the relationship between environmental

degradation and migration is much more complicated and much less linear than envisaged in the early models and projections (Black et al. 2011a: S3-S4; Hermans & McLeman 2021).

Third, and more specifically, there was no theorizing about migration aspirations and capabilities, as has become standard in current migration research in the social sciences, rendering simple push-pull analysis obsolete (see, e.g., de Haas et al. 2019). Most of the world's population are not and do not want to become migrants, and certainly not international migrants, even when an external observer would perceive large push and pull forces. For example, even in such extreme environmental events as in the aftermath of the Japanese tsunami of 2011, the large majority of the population typically preferred to stay and rebuild (Black et al. 2011a: S6). Early studies treated environmental changes as primary pushing factors that linearly lead to more emigration whereas in reality people use diverse strategies to cope with environmental shocks (Niva et al. 2021). Many assessments posited migration as an inevitable outcome of declining habitability. Yet, it became clear that environmental stress rarely directly results in migration but works through a complex array of economic, demographic, social, and political determinants (Horton et al. 2021: 1282; Hoffmann et al. 2020: 910; Niva et al. 2021: 12; Hermans & McLeman 2021).

Fourth, as a result of the previous problems, early models yielded the wrong predictions. For example, it appeared that people continue to be as likely to migrate *into* places that are vulnerable to the impact of climate change as they are to move *away* from them (Black et al. 2011b: 448). Megacities like Dhaka (Banghladesh) and Lagos (Nigeria), both located in a major river delta and coastal floodplains, are at high and increasing risk of flooding but still attract millions of additional migrants (Black et al. 2011b: 448). Between 1990 and 2000, nearly half of global in- and out-migration took place between areas of high environmental stress and low capacity to adapt to it (Niva et al. 2021). Based on linear push-pull analysis, one would expect highest emigration rates in areas characterized by high environmental stress and low adaptive capacity, while one would expect high positive immigration rates where environmental stress is low and adaptive capacity high. However, recent empirical analysis has shown that this is not the case. For example, net outmigration per capita is highest where both environmental stress and adaptive capacity are low. In many of such areas, also net immigration is high, which is also the case in regions with high environmental stress but also high adaptive capacity (Niva et al. 2021: Figure 4). Actually, the clusters of areas that exhibited the majority of global net-positive and net-negative migration appeared to have similar profiles (Niva et al. 2020: 7).

In sum, empirical evidence has by now revealed that environmental factors shape migration flows in interaction with numerous micro-, meso-, and macro-level social factors (Black et al. 2011a; Hunter et al. 2015; Hoffmann et al. 2020), which is consistent with established, more general social scientific migration theories that try to explain migration aspirations as well as capabilities (cf. Pitoski et al. 2021; de Haas et al. 2019). At the same time, the early generation of research has yielded a number of concepts that have by now become established in the field of climate migration studies.

3. Established concepts in climate migration studies

It would be misleading to treat "climate migration" as one monolithic type of mobility. There are a number of distinctions to be made that can be organized, following Detges et al. (2022) along three dimensions: time, space, and agency.

With respect to climate change and its potential impact, a well-established distinction in the temporal dimension is the one between **fast (or sudden, or rapid) onset events** like floods, storms and hurricanes on the one hand and **slow onset events** with more gradual impact on the other. Examples of slow onset events include processes like erosion, rising sea level, drought, desertification, biodiversity loss, glacial retreat, land and forest degradation, and increasing climate variability. These are major processes with major longer-term hazards, potentially making lands uninhabitable, and irreversibly so, for example when coastal erosion and a rising sea level "swallow" small islands and coastal areas. Yet, most of the public attention goes to dramatic, rapid-onset events (Zickgraf 2021: 21-26). Important to keep in mind is that slow and fast-onset events correlate, e.g. increasing climate variability is a gradual process leading to more frequent rapid-onset extreme weather events; rising sea-levels (slow process) are augmenting the risk of coastal flooding (rapid onset). Boundaries between slow- and fast-onset events are fluid and events range on a continuum between the two (Hugo 1996; Zickgraf 2021).

Still with respect to the temporal dimension of migration, it is essential to distinguish **migration** as a change of habitual residence from more short-term forms of **mobility** and **circulation**. Boas et al. (2019) even argue against the use of the expression "climate migration", as it "does not capture the diverse ways in which people do or do not become mobile in response to a changing climate; the term should therefore be avoided. Some people may temporarily (or even seasonally) move, while others may permanently relocate to nearby urban centres" (p.902). They therefore are in favour of studying *mobilities* (rather than migration) in relation to climate change. Nevertheless, from a demographic perspective, it still makes sense to distinguish between temporary (perhaps seasonal) forms of mobility, including those forced by extreme weather events, and mobility with the intention to change the place of normal residence, i.e., migration. Whether the migration turns out to be permanent or not (in case of return migration) can only be known with the benefit of hindsight.

In the space dimension, research distinguishes between short versus long distance moves, **national versus international** (or cross-border) and even intercontinental migration, as well as migration between rural and urban areas. So far, research has found that climate change related migration largely takes place within the boundaries of nation states, with **rural-to-urban** migration being the most commonly found and studied type of migration (see McLeman & Gemenne 2018; Zickgraf 2021; Hoffmann et al. 2020; Šedová, Čizmaziová & Cook 2021 for overviews). When cross-border, the evidence shows that most climate induced migration tends to occur between neighbouring countries or within the same region. All in all, climate migration tends to be short-distance (Niva et al. 2021: 12). For example, in Bangladesh, moving to cities has become a common coping strategy after flooding (Black et al. 2011b). In Latin America and the Caribbean, it was found that when confronted with drought, younger people typically favour traveling short distances and relocating to nearby towns (Baez et al. 2017).

The literature has identified several reasons why climate change migration typically is on relatively short distances and within the borders of a nation state. One is that longer distance and international migration require greater resources (financial, social, political, ...). Many people do not have the adequate resources for migration on longer distances, especially in poor countries (Hugo 1996; Zickgraf 2019; Cattaneo et al. 2019). Another reason is place-

attachment (Hoffmann et al. 2021: 3): people try to avoid moving too far away in order to not lose important assets like their social connections, livestock, and property such as land and a family house.

Agency is a third important dimension when considering climate migration, with the most rudimentary distinction being the one between voluntary and involuntary or forced migration. In the case of climate change induced migration, the distinction is not always clear. For example, many people may feel forced to move in case of very extreme weather events while others even refuse to move when authorities try to force them. Studies on mobility in response to climate change often distinguish between three sorts of mobility: migration in the proper sense, displacement, and planned relocation (Zickgraf 2019). The distinction relates to by who and under what conditions the move is decided. Movements are called **displacements** when they are associated with discrete events that challenge safety, security or livelihoods. Much displacement is involuntary or forced, and sometimes sudden if associated with rapid onset hazards. The other forms of mobility are interpreted as more proactive moves to improve livelihoods and opportunities. They are typically voluntary and planned (Black et al. 2011a: S6).

A related distinction is between ex-ante and ex-post migration. Ex-ante migration is considered as a risk diversification and insurance strategy for families, as a preventive investment to cope with the expected effects of worsening conditions. Ex-post migration is considered as a coping strategy after sudden events leading to adverse conditions and income loss (Hunter et al. 2015; Hoffmann, Šedová & Vinke 2021). Ex-ante migration may be expected to be related to slow-onset processes while ex-post will be more in response to fast-onset events. What has not yet been studied a lot is the role of expectations for the future: if people expect extreme events to become more frequent, will they be more likely to make plans to move out?

4. Framework: Ready, Willing, and Able?

Not everyone who is living in adverse climatic conditions is ready, willing and able to move. Many people who should do better to move out in the eyes of an external observer, still prefer to stay. And many who would like to migrate to a better environment are unable to do so. While migration may be one possible adaptation strategy to deteriorating climatic conditions for some people (Sakdapolrak et al. 2024), vulnerability to climate change does not necessarily lead to a higher likelihood of out-migration. Under some circumstances, climate change may in fact impede migration (Cattaneo et al. 2019). Environmental factors may and will affect both aspirations and capabilities driving migration decisions, but they never do so in isolation; they affect these drivers in interaction with, and in the context of, economic, political, socio-cultural and demographic factors. In order to connect these more distant contextual factors with actual migration decisions, I propose to apply the RWA-framework.

In demography, a classical framework to analyse the diffusion of fertility control in the course of the demographic transition is Ansley Coale's Ready-Willing-and-Able-framework (RWA), further developed and applied by Ron Lesthaeghe (Coale 1973; Lesthaeghe & Vanderhoeft 2001). In order to adopt some demographic behaviour like family size limitation, people need to be not just ready and also willing, but at the same time also able to adopt it. I propose to apply this RWA framework also to the case of (climate) migration.

The **readiness** condition implies that migration must be viewed as advantageous: people must have the idea that they would be better off migrating. In the context of climate change, one of the reasons for *not* being ready may be a lack of information about the risk associated with climatic events. Migration may be perceived as totally irrational, in such case. Or, in the case of fast-onset events, people may remain immobile because messages of warning are not received (Cattaneo et al. 2019: 194).

Even when people perceive the advantages of moving, they may not be **willing** to do so. Willingness implies that moving out must be seen as culturally acceptable. This is not self-evident, since cultural beliefs, values, norms and attitudes may impede migration. These include, for example, cultural beliefs regarding the risks associated with moving, which may imply self-imposed limitations on migration (Beck 1992; Williams & Baláž 2012). Or, people may also feel obliged to stay in order to care for elderly family, for example, and therefore not willing to move even if they see the advantages and would therefore be ready for it.

Third, people who are ready and willing may not be **able** to do so because of lack of means. In the context of climate migration, the concept of "trapped populations" refers to those who have high incentives to move, for instance because of very bad climatic conditions, but lack the means to do so (Black et al. 2013; Cattaneo et al. 2019: 194). When climate change reduces the resources needed to migrate, it may also result in less rather than more migration (Black et al. 2013; Zickgraf 2019). This insight is central to the "migration hump theory" (attributed to Martin and Taylor 1996, cited in Hoffmann, Šedová & Vinke 2021: 3 and Niva et al. 2021: 2): liquidity constraints reduce the likelihood of emigration for poor segments of the population, so adverse conditions (possibly due to climate change) lead to more outmigration only for those who can afford it. As a result, on the macro-level, there exists an inverted U-shaped relationship between economic development and migration (Niva et al. 2021).

All three conditions need to be met; each is a *conditio sine qua non*, which implies that each of these three can act as a bottleneck: if people are willing and able, but not ready to migrate, they will not do so. The perspective is similar to the aspirations and capabilities framework (de Haas et al. 2019) but offers a richer view, notably with respect to highlighting the cultural dimension inherent in the willingness condition. In the capabilities and aspirations framework, willingness and readiness are combined under the heading of the aspirations. Making explicit that both willingness and readiness are needed for migration to occur highlights that both actual and perceived differences in potential drivers of migration, as well as their interplay, may affect migration flows (Black et al. 2011a).

The impact of climate change on migration, like migration in general, is likely to depend on the socioeconomic and political context and features of individuals, households, and the communities they live in. Migration will therefore depend on factors such as financial, educational and social capital, gender, age, health, possible places to move to, and the capacity to track what happens with the environment. A conceptual approach, going beyond the simplistic push-approach of the first generation of research on climate migration, was pioneered by Black et al. (2011a) and the Foresight Report on Migration and Global Environmental Change (2011). These approached climate related migration from the interplay between, on the one hand, the vulnerability to environmental change of a given

population and society and, on the other, its adaptive capacity, both of which are conditioned by the level of social, economic and political resources.

Climate change can increase the incentives to move, but it can also limit the capacity to do so. It should be seen as affecting the many linked drivers of migration (Black et al. 2011b). Not just the place of origin should be considered but also the places where potential migrants may or may not move to (Niva et al. 2021: 2). Taking this into account, the impact of the level of resources is mediated by at least the following three channels that may sometimes run in countervailing directions. First, high resources typically imply higher adaptive capacity to cope with the impact of climate change (for example by installing air conditioning), so lower vulnerability when staying instead of migrating. Second, and on the other hand, high resources enable people to move away from adverse circumstances in the region of origin and, third, to adapt to new circumstances in potential regions of destination. The first channel of influence would predict lower migration for those with more resources, the second and third more migration (Niva et al. 2021).

Going beyond an approach in terms of having few or a lot of resources, Black et al. (2011a) distinguish between five groups of drivers of migration: environmental, economic, political, socio-cultural and demographic drivers. These rarely act in isolation and it is the interaction between the five drivers and their effects on readiness, willingness and ability that is of critical importance. Both actual and perceived differences in each of the drivers and their interplay may affect migration flows through RWA (see Figure 1).

A. Environmental drivers

While environmental drivers have largely been absent in mainstream social science theories of migration until recently, this is now changing as a result of the growing research interest in climate change in the social sciences. Different kinds of climatic hazards have differential effects on the livelihoods of populations and may amplify but also suppress migration (Hoffmann 2020: 910).

Climate change primarily manifests itself in changes to the weather patterns and increasing sea level (due to thermal expansion of sea water and inputs from melting land ice). Five dimensions of this may affect migration (Black et al. 2011a).

1. A rising sea level leads to higher risks of coastal flooding, with faster erosion of coastal land and increased saline intrusion and salinisation of low-lying agricultural land (Black et al. 2011a: S8; Horton et al. 2021).
2. Increased frequency and intensity of tropical storms and cyclones, increasing also the risk of flooding and damage. This has already been linked to temporary migration in Vietnam (Berlemann & Tran 2021).
3. Changes in rainfall regime may also affect migration (Milan & Ruano 2014). For example, for a sample of 41 countries in sub-Saharan Africa, it has been shown that lower rainfall and lower variability in rainfall has increased subsequent rural out-migration among young adults (but not or much less among the older parts of the population) (Weinreb et al. 2020).
4. Increased average temperature, with the often implied more frequent high-temperature extremes and heat stress, affecting crop productivity in agriculture, has been linked to migration as well (Mueller et al. 2014; Kaczan & Orgill-Meyer 2020). The faster melting of glaciers in the Andes in South-America has led to decreasing water supply,

while run-off from glacier basins is an essential element in the water supply for agriculture, drinking water as well as energy production (Kaenzig & Piguet 2013).

5. Changes in atmospheric chemistry may be good for some but not for other crops, and will affect ocean chemistry and so the productivity of coastal and marine ecosystems (Black et al. 2011a).

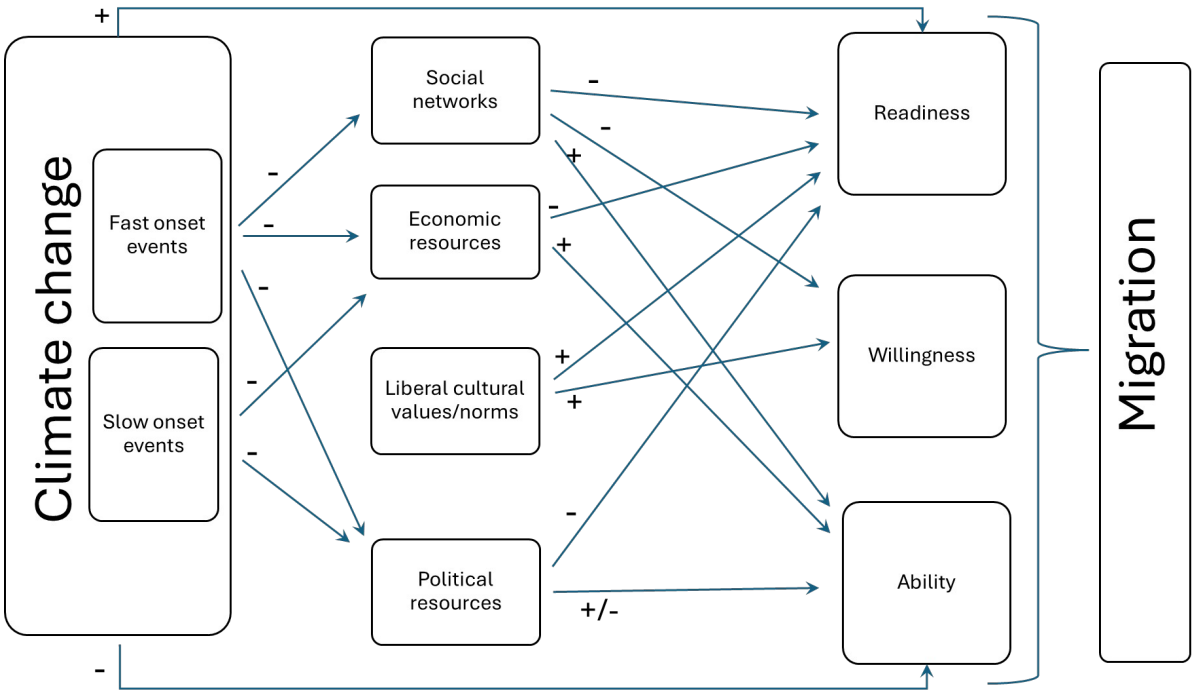
It is important to consider the combination of these factors. For example, co-occurring extremes of high temperature and high humidity can threaten habitability as humid heat is particularly harmful to human health. Especially the elderly are vulnerable, with increased mortality due to combination of heat and humidity (Horton et al. 2021: 1281).

Environmental drivers may exert their influence on migration through exposing populations to hazards like floods and heatwaves, or alternating successive periods of droughts and floods (Niva et al. 2021: 13) on the one hand, but also through the (declining) availability of ecosystem services. **Ecosystem services** are those aspects of the ecosystem that are utilized by humans to secure their wellbeing. This includes functions of provisioning (providing food and water) and regulating (e.g. protection from erosion), as well as cultural services (like having emotional or spiritual value) (Black et al. 2011a: S7). Three aspects by which ecosystem services affect the wellbeing and livelihood of populations are their availability, stability and ease of access. This is particularly and most directly true in economies dominated by agriculture, but indirectly in other economies just as well (Black et al. 2011a: S7). The majority of the world's population remains directly dependent on access to freshwater (Lenton et al. 2023: 3). Water stress occurs when the demand for water exceeds the available amount during a certain period or when poor quality restricts its use. The population living under water stress is expected to grow by between 50 and 100% between 2010 and 2050, depending on the emission scenario (Munia et al. 2020).

Environmental drivers of migration are not limited to climate change. They also include processes like land degradation and the degradation of coastal and marine ecosystems, which may or may not be a consequence of climate change but anyway has the potential to affect migration (Black et al. 2011a; Hermans & McLeman 2021). Land degradation is the deterioration in the quality of land used for agriculture and the provision of ecosystem services, as represented for example by loss of nutrients, pollution by salinization or exposure of toxic materials and loss of soil through erosion. There are strong indications that land degradation will disproportionally be felt in low income countries and will notably have adverse economic consequences for rural populations in the Global South (Barbier & Hochard 2018). To what extent it will lead to more migration will depend on the alternative livelihood strategies of households to adapt to the degraded land (Hermans & McLeman 2021). Diminished soil quality has motivated people in Kenya to emigrate in order to diversify the incomes of their households. Households possessing high-quality soil were much less likely to have migrating members than households using poor soils (Black et al. 2011b: 448). In drought-prone northern Ethiopian highlands, migration is a common livelihood strategy, with land degradation, crop failures and water scarcity triggering high levels of temporary labour migration on short distances. At the same time, many people who may be motivated to migration lack the means or the ability (for health reasons for example) to do so, or others are attached to their land and/or livestock (Hermans & Garbe 2019).

A changing environment may affect migration readiness and willingness through **direct** as well as **indirect** channels (see Figure 1). Coastal erosion forcing the inhabitants of a village to relocate; or when people have to flee a hurricane or a flood are examples of direct effects (Cataneo et al. 2019:191). Indeed, floods may pose an immediate threat to the health and wellbeing of families (Muttarak & Dimitrova 2019). Indirect effects are at play when climate change affects other drivers of migration, such as economic or political conditions (Hoffmann et al. 2021: 3), for example when global warming affects traditional farming practices locally and when this stimulates some farming families to leave because of declining agricultural yields. Typically, reality combines direct and indirect effects of environmental changes happening on a continuum between fast- and slow-onset, with the resulting migration, if any, being on a continuum between voluntary and involuntary (Cataneo et al. 2019:191).

Figure 1: Direct and indirect drivers of readiness, willingness and ability of climate migration



Not many studies explicitly address the **duration** of migration, or whether it was temporary or permanent (Zickgraf 2021: 26). Fast-onset events such as hurricanes, torrential rains, floods, and landslides are manifest and brutal. Research so far generally has found that in most cases, displacements tend to be temporary and over short distances (McLeman & Gemenne 2018; Zickgraf 2021). For example, in Bangladesh, moving to cities has become a common coping strategy after flooding (Black et al. 2011b). Call et al. (2017) found that temporary migration declines immediately after flooding but quickly returns to the previously observed pattern. In contrast, high temperatures were found to have sustained positive effects on temporary migration, while migrations decrease during extended periods of extreme precipitation. Hence, the common assumption that flooding, precipitation extremes and high

temperatures will consistently increase temporary migration does not seem to be true (Call et al. 2017). In Latin America and the Caribbean, it was found that when confronted with drought, younger people typically favour traveling short distances and relocating to nearby towns (Baez et al. 2017). The evidence so far clearly and consistently shows that the majority of those who are displaced return as soon as possible in order to protect and restore their property after a disaster (McLeman & Gemenne 2018). When it comes to migration rather than short-term displacement, the frequent succession of fast-onset disasters may have a stronger effect than the intensity of each single event as such (Cattaneo et al 2019: 191). Here, again, perceptions matter: when extreme events are perceived as becoming more frequent, they may stimulate the readiness to migrate.

Most of the public attention as well as the scientific evidence about climate mobility goes to the impact of dramatic, rapid-onset events (Hoffmann et al. 2021; Zickgraf 2021). For example, in 2019, almost 25 million people were forced to flee from storms, floods or other catastrophes. Since the impact of climate change runs also through gradual change, we need more research about the impact of slow-onset events like rising sea level, drought, desertification, biodiversity loss, glacial retreat, land and forest degradation, and increasing climate variability. Slow-onset processes like these may in fact have a greater impact on mobility (Zickgraf 2021: 21-22), especially when talking about longer-distance, international migration rather than short-term and more local moves. Indeed, a recent study concluded that slow-onset environmental factors (more specifically drought and water risk) are likely to be dominant environmental factors behind global migration flows (Niva et al. 2021).

To the extent that slow processes lead to more frequent rapid-onset events, research about the latter transfers to the impact of slow-onset implications of climate change and studies on short-term impacts can be used to estimate the longer-term climatic impacts (Hoffmann et al. 2021: 3). Nevertheless, slow- and fast-onset events are expected to have diverging effects on mobility. Slow-onset events are more likely to stimulate pre-emptive and proactive forms of migration since they allow more time for planning and preparations. Sudden-onset events, in contrast, are seen as causing involuntary and reactive displacement leaving no time for careful decision making (Zickgraf 2021: 27).

The existing empirical evidence about the impact of slow-onset climate change phenomena on migration remains ambiguous. On the one hand, a number of studies document mass-departures in response to drought, for example in Niger. However, most of the mobility remains within the borders of the impacted nation state (Cattaneo et al. 2019: 192). On the other hand, the number of people migrating generally remains low relative to the number actually affected by drought, suggesting that climate change is just one of the many factors affecting the migration decision, with other factors like political issues often being key and migration often only marginally related with environmental factors (Cattaneo et al. 2019). Slow-onset events such as droughts can actually reduce rather than increase migration flows. For example, Mali in the 1980s witnessed a reduction in international migration due to a lack of available resources to enable the move (Cattaneo et al. 2019: 192). More generally, it has been shown that a gradual increase in temperatures reduces international migration out of poor countries. Only for middle-income countries, there is evidence that drought leads to increased migration readiness and ability; i.e. countries that are neither rich enough to pay insurance schemes nor poor enough to be locked due to liquidity constraints (Cattaneo et al. 2019: 192). Drought may cause an increase in the number of people who migrate on short-

term and short-distance types of migration, but there is no evidence so far that it increases international migration, rather on the contrary (Cattaneo et al. 2019: 192). The evidence so far suggests that slow-onset environmental events like droughts and increasing temperature leads to either immobility (perhaps due to lack of ability) or to migration that tends to be perceived as voluntary and predominantly economically motivated (increased readiness). On the contrary, fast-onset events tend to lead to more sudden and short-term and –distance movements that tend to be perceived as involuntary (Cattaneo et al. 2019: 192).

All in all, migration is not an inevitable consequence of these environmental drivers but should rather be considered next to other adaptive strategies (cf. Sakdapolrak et al. 2024) (as well as morbidity and mortality risks). Air conditioning and other technological adaptation enable some people to continue in places that would otherwise not be survivable at all. This will increase inequality and those who cannot afford the technology will be forced to migrate (or die) (Horton et al. 2021: 1281).

B. Economic resources

Economic factors play an important role in shaping climate-related migration. Climate change increasingly undermines economic stability, particularly in the Global South, where many depend on agriculture and often lack the resources to adapt effectively (Cattaneo et al., 2019). Declines in rainfall, for example, have weakened economic growth in sub-Saharan Africa (Barrios et al., 2010), while rising temperatures harm agricultural and industrial output, exacerbating poverty and political instability (Dell, Jones & Olken, 2012). These economic impacts influence migration readiness as households seek ways to mitigate worsening conditions.

Migration often serves as a strategy to diversify risks, especially for families facing slow-onset climate processes like land degradation or rising sea levels (Hunter et al., 2015; Hoffmann, Šedová & Vinke, 2021). It can act as a proactive investment to secure income and stability in adverse conditions. However, migration is just one of several adaptive responses, alongside agricultural adjustments, economic diversification, and reliance on social safety nets (Cattaneo et al., 2019).

Paradoxically, while climate impacts may enhance the incentives for migration, economic constraints often prevent the most vulnerable from moving. The poorest households, who face the highest exposure to climate risks, are often least able to afford migration, leaving them particularly vulnerable (Cattaneo et al., 2019). Migration costs—especially for long-distance or international moves—are prohibitive for many. For instance, international migration can cost up to four times as much as short-distance moves (Kleemans, 2015). This financial barrier underscores a "double risk" for the poor: they are both unable to escape climate threats and disproportionately affected by them (Cattaneo et al., 2019).

The type of migration also reflects economic inequalities. Poor households often engage in short-term and short-distance migration, known as survival migration, to cope with immediate shocks such as floods or droughts (Kleemans, 2015; Hunter et al., 2015). In contrast, wealthier families pursue long-term, long-distance investment migration, which involves greater planning and resources (Cattaneo et al., 2019). For example, studies in Indonesia have shown that low-income households typically respond to short-term shocks by making temporary rural moves, while wealthier households are more likely to pursue urban, long-term relocations. These two strategies frequently act as substitutes: families that spend

resources on short-term survival migration are less likely to undertake longer-term investment moves (Kleemans, 2015).

Economic status also explains broader migration trends. Middle-income groups are generally the most likely to migrate, as they have enough resources to move but still face economic pressures to do so (Hoffmann et al., 2020; Šedová, Čizmaziová & Cook, 2021). In contrast, the poorest often cannot afford to migrate, while the wealthiest tend to have fewer incentives to leave. This "inverted U-shape" relationship has been observed in climate migration but also more broadly in migration studies unrelated to climate (de Haas, 2023). Such findings highlight the critical role of economic resources in shaping mobility.

Recent research reinforces the idea that socioeconomic factors outweigh direct climate drivers in determining migration patterns. A global dataset on migration from 2000 to 2019 reveals that economic variables such as income, health, and education are more predictive of migration than climate factors as such (Niva et al., 2023). Income consistently emerges as the strongest predictor of migration, with health and education also playing significant roles (Niva et al., 2021). These findings emphasize that while climate change exacerbates migration pressures, economic capacity ultimately determines who is able to migrate and how far they can go.

In summary, while environmental changes may create strong incentives to move, economic constraints often limit mobility for the most vulnerable populations. Middle-income groups are the most likely to migrate, while the poorest are more likely to remain trapped in high-risk areas. Policymakers must address these dynamics by reducing barriers to migration, enhancing adaptive capacities, and providing support to those most at risk. Effective policies can help mitigate the economic and social impacts of climate change and ensure migration serves as a viable strategy for resilience (Cattaneo et al., 2019; Kleemans, 2015; Niva et al., 2023).

C. Political drivers

The influences of political factors manifest themselves in areas such as governance effectiveness, conflict and security, policy-making, and historical political structures. These may exacerbate or mitigate the effects of climate factors.

Governance plays a pivotal role in shaping societal adaptive capacity to climate change. Effective governance enhances adaptive capacity, mitigating the need for migration, while poor governance can exacerbate vulnerabilities (Black et al., 2011b; Niva et al., 2021). Mismanagement of resources and ineffective policies can worsen the effects of climate-related hazards, prompting migration. Or, maladaptive policies may also hinder mobility and relocation in case of climatic emergency. For example, poorly designed evacuation plans in the aftermath of Hurricane Katrina in New Orleans assumed universal car ownership, leaving many vulnerable populations unable to escape the disaster (Black et al., 2011b).

Climate change can indirectly drive migration by exacerbating **conflict and insecurity**. Drought and resource scarcity may heighten competition, triggering armed conflicts that displace populations. Abel et al. (2019) demonstrate that climatic conditions increased drought severity and the likelihood of conflict, influencing asylum applications from Western Asia during 2010–2012. Yet, conflict can also hinder migration. In Somalia, ongoing violence prevented pastoral communities from relocating during the 2000 drought (Lindley

2014). This dual role underlines the context-dependent relationship between climate, conflict, and migration.

Kelley et al. (2015) highlight how prolonged drought in Syria, linked to unsustainable agricultural practices and poor water management, amplified existing vulnerabilities and contributed to migration. However, the notion of a "climate war" as a primary driver of migration has been contested, with scholars like Fröhlich (2016) and Selby et al. (2017) emphasizing the complex and context-specific interactions between climate, conflict, and migration. Selby et al. (2017) found no conclusive evidence that climate change was a significant factor in Syria's pre-civil war drought. They also dispute claims that the drought caused the alleged scale of migration or that such migration pressures contributed to the onset of the civil war. Their findings underscore the importance of scrutinizing claims about climate-driven migration and conflict. Rather than climate per se, ineffective agricultural and water management policies and existing socio-economic inequalities played a more decisive role in Syria.

Colonial histories have shaped settlement and land tenure patterns, political borders, and crop systems that continue to affect today's migration patterns in response to changing environmental conditons (Hunter et al. 2015: 381). In Guatemala, for example, colonial legacies of unequal land tenure and inadequate policies continue to drive migration from degraded agricultural areas. Generally, people without land are more likely to move in case of bad climatic conditions (Hunter et al. 2015: 381-382).

Border control policies, particularly in high-income countries, often focus on deterrence rather than facilitation of migration as an adaptive strategy for people facing adverse environmental conditions. In the media and in politics, climate migration is often cast in a negative light. This is likely to contribute to the already high risks faced by those most hit by the implications of climate change in their ecological environment. Indeed, as pointed out by Black et al. (2011b: 447), the greatest risks "will be borne by those who are unable or unwilling to relocate, and may be exacerbated by maladaptive policies designed to prevent migration." In Europe, for example, migration policies have increasingly shifted in recent years toward "closing the borders" to people coming from outside the EU/Schengen region (Van Bavel 2020; Fransen and de Haas, 2022; PDR 2022). This will increase the risks for those most vulnerable to climate change impacts. Yet, restrictive border control policies can inadvertently stimulate more migration by preventing circular or temporary mobility patterns. For example, Senegalese fisher families have benefited from bilateral agreements with Mauritania, allowing them to fish abroad while maintaining ties at home. This mobility fosters economic resilience and mitigates the need for permanent migration, but it gets lost when borders are closed (Zickgraf, 2019).

D. Cultural drivers

Cultural factors mediating the impact of environmental factors in driving migration include cultural norms and values, including in particular family-related practices regarding marriage, gender and inheritance. Not everyone is entitled to migrate in all circumstances, alone or not. For example, family members may be normatively expected to stay with the head of the household instead of being free to move. In line with such norms, it was found in rural Ethiopia that members without a family tie to the household head were much more likely to move in response to droughts (Hunter et al. 2015: 383). Gender differences significantly

influence vulnerability to climate change and migration tendencies during climate emergencies. Women are more vulnerable due to gendered access to social, financial, and political resources and labour opportunities, affecting their readiness, willingness and ability to migrate (Gioli & Milan 2018; Lama et al. 2020). Studies show that women are more likely to experience adverse impacts from climate change, such as food insecurity and health issues, which can drive migration as a coping strategy. In Bangladesh, it was found that women were more likely to migrate after crop failures and flooding, perhaps due to their less secure access to land as a result of gender norms (Gray & Mueller 2012). Deforestation in Ghana, on the other hand, was associated with increased rural-urban migration much less among women than among men, probably because there were more employment opportunities for the latter in the urban environment (Hunter et al. 2015: 383). Also, women often play crucial roles in community resilience and local adaptation efforts, which may make migration less likely (Ravera et al. 2016).

E. Social capital and networks

Social capital and networks, related to education, also affect the vulnerability and likelihood of migration in case of climatic events (Black et al. 2011; Pitoski et al. 2021). Social connections in potential places of destination reduce the cost of migration, while having a lot of social capital in the place of origin reduces vulnerability while increasing the cost of leaving (Hunter et al. 2015: 384). In migration studies, such network effects are captured in the cumulative causation perspective: after a critical mass of people from region A have moved to region B, further migration from A to B will become less costly and more likely (Massey 1990). Hunter et al. (2013) found that that households subjected to recent drought conditions in rural Mexico are far more likely to send a family member to the U.S., but only in communities with strong migration histories. In regions lacking such social networks, rainfall deficits actually reduce migration propensities, perhaps reflecting constraints in the ability to engage in migration as a coping strategy.

Household demography determines the age and gender composition of households, the available labour pool and, as a consequence, viable livelihood strategies. Households with young adults are more prone to rural-urban mobility, often circular, as an additional livelihood strategy among families living mostly from agriculture. Non-agricultural labour after migration can provide extra cash to economically buffer households, both ex-ante as ex-post environmental shocks (Hunter et al. 2015: 383).

The gravity model of migration formalizes the established empirical regularity in spatial demography that flows of migrants are positively associated with population stocks at origin and destination and inversely related to distance (Coimbra Vieira et al. 2024). Yet, demographic factors affect migration mostly in interaction with the other drivers discussed. For example, it is not so much the mere number and age composition of people in an area but rather the presence of large number of people without employment or livelihood opportunities that triggers migration (Black et al. 2011: S6). A recent study found that cultural distance (rather than geographical distance) between A and B plays a key role in predicting migration (Coimbra Vieira et al. 2024).

5. Habitability and immobility

Early climate migration studies often assumed that worsening habitability due to climate change would directly drive migration. However, these studies largely emphasized physical conditions over local sociocultural circumstances and adaptive capacities, overlooking human agency and creativity in finding collective solutions. Migration is just one of many adaptation strategies to worsening environmental conditions (Horton et al. 2021). This highlights the need to consider habitability from a sociological perspective, a concept largely absent in social scientific migration research and social demography in general. At the same time, the previous discussion of the factors in Figure 1 suggest that people may face uninhabitable conditions but still remain immobile. This is captured by the concept of trapped populations, whose survival is endangered due to climate change but still do not migrate (Black et al. 2013; Cattaneo et al. 2019).

A. Habitability

Traditionally, habitability has been used mainly in astrophysics and geosciences (Borderon et al. 2023). It has now become clear that habitability encompasses not only physical-ecological dimensions but also sociological ones. Defined as the capacity of a site to sustain human life and livelihoods, habitability includes three dimensions: 1) physical survival, 2) livelihood security, and 3) societal resilience. These dimensions provide the foundation for a population to remain in an environment intergenerationally, pursuing individual and collective wellbeing, self-actualization, dignity, and development (Horton et al. 2021). Beyond physical factors, habitability depends on governance, infrastructure, and collective human choices (Wrathall et al. 2023), including the cultural and sociological factors indicated in Figure 1: beyond the environmental conditions related to climate change (on the left hand side of the diagram), the habitability of a place also depends on social networks, economic resources, cultural values and norms, as well as political resources.

Some areas may become physically uninhabitable due to climate change. For example, a wet-bulb temperature of 35°C, combining heat and humidity, surpasses human survivability beyond six hours (Horton et al. 2021). In 2020, around 1% of Earth's surface was uninhabitable due to extreme climatic conditions, potentially growing to 20% by 2070 without significant emission reductions (Xu et al. 2020). The human climate niche—defined by climatic conditions supporting high population densities—has remained stable historically, with peaks at mean annual temperatures of ~13°C and ~27°C (Lenton et al. 2023). This niche is shaped by direct effects on human health and behavior and indirect effects on the species and resources that sustain us. As global temperatures rise, billions may find themselves outside this niche, affecting health, livelihoods, and displacement. Under current policies (SSP2-4.5), 1.2 billion people may be outside the niche by 2030, rising to 3.7 billion by 2090 when accounting for population growth. Worst-case scenarios project up to 5.3 billion people outside the niche by 2090. Despite technological advances, expanding the human climate niche remains limited, particularly for subsistence farmers reliant on stable conditions. Global warming and population growth have already pushed over 600 million people into less favorable conditions (Lenton et al. 2023).

Migration of a growing share of the population may signal declining habitability and is expected when the changing environment alters people's judgments about the desirability, stability, or predictability of environmental living conditions compared to other accessible

locations. Individual judgments about habitability change over time and are inter-subjective. Ultimately, habitability is a collective choice that people invest in (Wrathall et al. 2023).

To avoid environmental determinism, the concept of habitability needs insights from the social sciences, similar to the concept of the earth's "carrying capacity" (Sayre 2008). Habitability depends not only on physical ecological conditions but also on what people want to do, are able to do, and how they organize themselves, including governance and infrastructure. Physical dimensions of habitability do not always have the biggest or fastest impact on migration. For example, as sea levels rise and flooding becomes more common, social, economic, and political factors may induce a loss of habitability sooner than physical hazards like permanent inundation. Increases in insurance premiums could negatively affect asset values and tax revenues, leading to deteriorating infrastructure and services (Horton et al. 2021: 1281). However, any society always depends on a natural-material basis, so technological and social determinism should also be avoided (Borderon et al. 2023).

Habitability thresholds are changing. As globalization progresses, people's habitats are increasingly interconnected. This implies that livelihoods have become translocal, and the habitability of places cannot be considered without considering their connectedness to other places (Borderon et al. 2023). For example, a rural site may yield insufficient resources to support a family, but remittances from migrants working in nearby or distant cities may enable the family to stay (Sakdapolrak et al. 2023). Connectivity also implies that populations may be "trapped" not only due to their inability to migrate in adverse climatic conditions but also due to their inability to utilize connectivity (through migration of family members or other means).

Social inequality also affects habitability: a place unlivable for one family may be acceptable for another (who can afford air-conditioning, for example. Habitability is unequally distributed along multiple and intersecting axes (Borderon et al. 2023). The generalized interdependency in the globalized world implies that the habitability of one place depends on the habitability of another, even if far away. For example, climate phenomena may lead to failures in key food-producing regions, resulting in price shocks that undermine food security among distant populations (Horton et al. 2021: 1280).

The relationship between habitability and migration is sometimes counterintuitive, as seen in the lack of outmigration from low-lying delta areas despite acute risks (Horton et al. 2021: 1282) or immigration into wildfire-prone regions in the U.S. (Clark et al. 2022). There are also reverse-causal relationships between habitability and migration: migration affects habitability for those unable or unwilling to leave vulnerable circumstances, either positively (through remittances) or negatively (when the working-age population moves out, leading to deteriorating economic and livelihood conditions) (Horton et al. 2021: 1282). So far, such important issues have remained unexplored in social demography.

B. Immobility and trapped populations

Climate change events that undermine habitability can both increase incentives to migrate and limit the capacity to do so, creating complex dynamics around human mobility (Black et al., 2011b). Environmental degradation does not always result in more migration; in many cases, it constrains mobility options, leaving individuals with little choice but to stay. Despite living in risky environments, many people choose to remain for various reasons, including economic, political, social, and cultural factors (Zickgraf, 2019). This dual reality—where

some are unable to leave and others are unwilling—has prompted a shift in academic and policy discussions toward immobility, which has so far been largely overshadowed by a predominant focus on migration.

Traditionally, migration has been viewed as the exceptional response requiring explanation, while staying put was taken as the default or "normal" behavior. Zickgraf (2019) challenges this assumption, arguing that immobility, particularly in the context of climate change, often deserves equal explanation. A central question emerging from this perspective is why so many people remain in stressful or seemingly uninhabitable environments. This shift reframes immobility as an active subject of inquiry, moving beyond the simple dichotomy of migration versus staying to examine the complex factors that drive individuals to remain in place despite significant environmental pressures.

When climate change reduces the resources needed to migrate, it may also result in less rather than more migration (Black et al. 2013; Zickgraf 2019). The concept of **trapped populations** refers to those who have high incentives to move, for instance because of very bad climatic conditions seriously undermining the habitability of the place of origin, but lack the means to do so (Black et al. 2013; Cattaneo et al. 2019: 194). Such populations are often among the most vulnerable to climate impacts, yet they remain in place due to financial, political, or social barriers, or due to disaster-induced losses. In some cases, immobility itself becomes a form of "displacement in situ," where individuals remain trapped in increasingly uninhabitable environments without viable alternatives. Climate migrants are sometimes portrayed as climate “refugees”, i.e., as forced to move. But the mirror image of forced mobility may be just as relevant: forced immobility as a form of "displacement in situ” (Zickgraf 2019: 3). Indeed, it has become clear from empirical research that migration as a coping strategy may be available only to some, perhaps more resourceful parts of the population while others can do nothing but stay in place because violent conflict or poverty, or because a disaster bereaved them of all resources needed to migrate. Early research on immobility primarily examined financial barriers to migration, but subsequent studies have expanded to consider social and cultural motivations as well as political constraints. Immobility can stem from a deep attachment to place, family obligations, or even the loss of resources needed to move (Zickgraf 2019).

Empirical studies provide further insights into the complex interplay between environmental factors and immobility. Call et al. (2017) found that extreme precipitation and flooding temporarily disrupt circular migration patterns, which often resume after the events subside. In contrast, high temperatures have longer-term positive effects on migration, leading to sustained movement. Droughts also reveal regional variations: in Ethiopia, drought was found to significantly reduce marriage migration among women, whereas in Mali, it had the opposite effect (Hunter et al., 2015: 383). These findings highlight the diverse and context-dependent nature of migration and immobility in response to environmental stressors.

In this perspective, important questions to be addressed in future research on climate change and migration related to readiness, willingness and ability include: why are so many not moving out of environments at high risk of extreme climatic events? Are they unable? For political or economic reasons? Aren’t they ready? Or are they unwilling for cultural reasons? So research may shift from assuming that staying is the default mode and moving is to be

explained towards addressing the question why people actually do stay in places considered uninhabitable.

6. Discussion: future outlook

According to the empirical evidence, so far, climate migration has rarely been permanent or long-distance. Typically, climate mobility has involved short-distance displacements, and often short-term (Call et al. 2017). A systematic review indicated that there is so far no evidence that climate change as such is an important driver of longer-term and long-distance migration flows, especially not for migration that would require crossing an international border (Pitoski et al. 2021). Fast-onset events, such as hurricanes and torrential rains, have not yet been shown to trigger long-term international migrations, though this could change as climatic patterns evolve. Projections for the future contain very large uncertainties.

Historically, migration theories have relied on linear push-pull models, suggesting that environmental degradation would push people from their origins while more favorable climates pulled them elsewhere (e.g., Myers 2002; Bierman & Boas 2010). However, empirical evidence challenges this approach, indicating that migration decisions are influenced by a complex interplay of micro-, meso-, and macro-level factors, including cultural beliefs, socioeconomic conditions, and institutional frameworks (Hunter et al. 2015; Zickgraf 2021). The interplay of these determines whether people are ready, willing and able to move. Theories of climate migration should incorporate more contextual factors, as well as consider inequalities in capabilities and aspirations to migrate, considerations of agency and structure, and give proper weight to the role of cultural beliefs, norms, perceptions and values (Hunter et al. 2015). Since this is social scientists' core business, we have a lot to contribute to this field of research.

Early projections about future climate migration often lacked nuanced theoretical foundations and failed to account for the complex interplay of factors influencing migration decisions. Projections tended to oversimplify the issue by equating exposure to climate hazards with inevitable migration, overlooking the multitude of barriers that can prevent people from moving. For example, some models estimate potential climate migration based solely on populations living in areas at risk of sea level rise, assuming migration will occur universally in response to such hazards. However, as discussed in depth above, exposure does not necessarily translate into mobility, as individuals and communities frequently adapt through alternative strategies, such as building sea defenses. This has been observed in regions like South and East Asia, where significant efforts to protect vulnerable coastal areas have mitigated migration pressures (Cattaneo et al., 2019: 192–193). In the Netherlands, for example, the advanced infrastructure of the Delta Project has provided resilience against rising seas, with more people moving into the protected area below the sea level (VanKoningsveld et al. 2008; Husby et al. 2013).

Many migration projections draw on historical data, combining past climate-related migration patterns with future climate scenarios. While these models offer insights, they are often limited to short-term responses and may either under- or overestimate the long-term impacts of climate change. Moreover, they face significant uncertainties, compounded by the inherent unpredictability of both climate and socio-economic scenarios on which the projections are based (Cattaneo et al., 2019: 193). For instance, short-term migration patterns influenced by

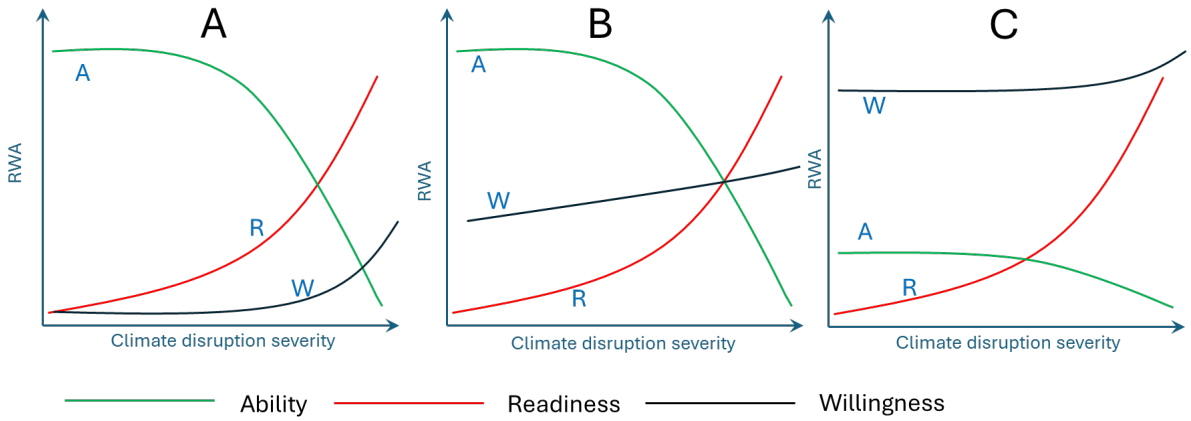
sudden climate shocks might not reliably indicate longer-term trends shaped by slow-onset climate changes like desertification or gradual sea-level rise.

One of the more advanced approaches to climate migration projection is seen in the work of Rigaud et al. (2018), which integrates demographic and socio-economic trends into migration modeling. This report estimates that by 2050, approximately 143 million people across Sub-Saharan Africa, South Asia, and Latin America may be compelled to move due to the slow-onset impacts of climate change, such as declining water availability, reduced crop productivity, and rising sea levels. The analysis in this report suggests that the numbers will accelerate after 2050 unless there are significant cuts in greenhouse gas emissions and robust development action. However, this projection focuses exclusively on domestic migration, highlighting the likelihood of movement within countries from areas of declining viability to those with relatively better prospects. The study underscores that the poorest and most climate-vulnerable regions will be hardest hit, with significant implications for infrastructure, social support systems, and climate-sensitive sectors unless urgent action is taken to reduce emissions and strengthen adaptive capacity.

Expanding on this foundation, Clement et al. (2021) broadened the scope of analysis to include East Asia and the Pacific, North Africa, and Eastern Europe and Central Asia, alongside qualitative studies on Small Island Developing States (SIDS) and eastern Arab countries. This study combined data from six regions to provide a global projection of domestic climate migration. Without proactive climate and development interventions, the combined findings suggest that as many as 216 million people could be internally displaced by slow-onset climate impacts by 2050. These movements are expected to originate in regions suffering from reduced water resources, declining agricultural productivity, and increased risks of flooding and storm surges. Migration "hotspots" are anticipated to emerge by 2030, intensifying by mid-century, with vulnerable populations disproportionately bearing the brunt of these pressures.

All in all, the impact of slow or fast onset events related to climate change on migration flows remains uncertain due to the uncertain and diverging effects on the readiness (R), the willingness (W) and the ability (A) to migrate, as illustrated in Figure 2. Panel A illustrates the situation where severe climate disruptions do not lead to more migration because the willingness to do so remains low, up to a certain point of very high disruptions that have undermined the ability to finally move away. Panel B represents a situation where the ability is still high enough when readiness and willing have moved up high enough to migrate, as indicated by the intersection of the three lines representing RWA. C represents a group with high willingness but low resources who, despite increasing readiness to migrate, are not able to do so. This illustrates how there are no straightforward forecasts to make that would predict much more migration as the impact severity of climate change increases.

Figure 2 Effect of severity of climate change impact on migration flows is uncertain due to uncertain and diverging effects on readiness, willingness and ability to migrate



The relationship between climate change and migration is multifaceted and defies simplistic explanations. Migration has always been a potential strategy for adapting to environmental changes, but it is only one among many. Contemporary research highlights the complexity of this phenomenon, showing that climate change does not uniformly lead to more migration; it can also result in immobility, where individuals or communities either lack the resources to move or choose to remain despite climatic challenges (Pitoski et al. 2021). This dual outcome complicates narratives that treat climate change as a straightforward driver of human migration. It is far from certain that more severe climate disruptions will inevitably lead to more international migration.

So far, research into climate migration has been geographically uneven. Studies are predominantly conducted in the Global South, where vulnerability to environmental hazards is highest, while the Global North focuses more on climate science. This disparity reflects underlying sociopolitical dynamics, including post-colonial and securitization framings that treat environmental migration as a "southern problem" and a potential security risk for the North (Piguet, Kaenzig, & Guélat 2018; Hoffmann et al. 2021). Bangladesh, for instance, is a frequently studied country, underscoring the focus on regions perceived as being at the forefront of climate vulnerability (Zickgraf 2021). There has been little engagement with indigenous knowledge and local perspectives in affected communities. Researchers from the Global North often lead investigations with their own priorities, which risks oversimplifying or misrepresenting the lived realities of climate-affected populations. Greater collaboration with these communities is essential for capturing the nuanced interconnections between climate mobility and related policy areas (Boas et al. 2019).

What has largely been lacking so far, is studies on the impact of the ongoing climate disruptions on mobility and migration in the Global North, including Europe and North America. The framework relating climate change directly and indirectly to the readiness, willingness and ability to migrate will be useful to formulate hypotheses. For example, a recent study about Florida in the USA quantified the impact of weather extremes (heavy rains and tropical cyclones) on the probability of mortgage default (Calabrese et al. 2024), affecting mortgage prices, in turn likely to affect migration ability as well as readiness.

So far, climate change and its relation to migration has not been a major focus in social demography. Just to illustrate: none of the references cited in this paper have been published in *Demography*, *Population Studies*, or the *European Journal of Population,* although these are flagship journals in the field. I predict that this will change in the next years. This paper has organized insights gained so far about climate migration from different disciplines into the RWA framework. This framework has already been used a lot to yield important insights about the diffusion of birth control. I hope that this paper will help social demographers to conduct studies that will enrich our understanding of the impact of climate change on migration as well as of the reasons why people may not move even if the circumstances seem to have become uninhabitable.

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