

The transboundary implications of climate-related coastal migration: state of knowledge, factors of influence and policy pathways

Esther Loiseleur, Alexandre K. Magnan, Ariadna Anisimov (IDDRI)

With sea-level change (SLC) (i.e. extreme events and sea-level rise related to anthropogenic climate change), coastal human migration might become a major issue in the twenty-first century, even if the figures will strongly depend on greenhouse gas mitigation, socio-political trajectories and adaptation efforts. Even if most of the mobility related to SLC will probably remain within national borders (i.e. relocation), this phenomenon raises major global-scale ethical and geopolitical challenges. Human mobility from or to coastal areas must not be considered as a risk in itself, as it has proven to be a potential opportunity for migrants, countries of origin and hosting countries. Migration is therefore considered in this study as an effective adaptation option, if chosen, prepared and anticipated in a fair and coordinated way by various actors. This calls for strengthened multi-level cooperation, and this *Study* develops an exploratory approach to the design of policy pathways: it relies on the identification of major factors of influence, which could trigger cascading effects, both positive and negative, and identifies key policy pillars at multiple scales in order to facilitate adaptation and resilience—whether through local adaptation strategies or adaptive migration when it is the best option available for communities and individuals. This integrated perspective allows for anticipating and tackling systemic issues in a context of a lack of historical analogues and uncertainties regarding migration thresholds and future mobility patterns.

KEY MESSAGES

Little knowledge exists on the cascading implications of coastal migration across borders and, as a result, there is limited work on enhancing adaptive migration and relocation when relevant.

Putting in place a governance framework and relevant policy tools (across scales and planned over time) to anticipate and prepare for migration *from* or *to* coastal areas can positively contribute to climate adaptation for migrants, the country of origin and destination.

This calls for an integrated approach of policies at multiple scales over time, in order to create synergies between national policies and international frameworks. This is what this study refers to as “policy pathways” (Fig. 4).

5 main policy pillars have been identified to tackle the main influential factors of risks related to changing migration patterns caused by sea-level change: (i) implementation of ambitious mitigation and international support for adaptation; (ii) effective coastal risk reduction policies; (iii) robustness of migration policies allowing for planning the movement of people across borders; (iv) enhancement of hosting capacities; (v) empowerment of communities and individuals through preparedness and right to decide.

Cooperation between different scales of action might prove beneficial as it could foster rapid progress and coherence, while a lack of coordination and delay in implementing some policy pillars might hinder progress and have negative feedback effects (Fig. 5).

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1. INTRODUCTION

With the global coastal population projected to exceed one billion people this century, sea-level rise (SLR) “might be among the most costly and permanent future consequences of climate change” (Hauer *et al.*, 2020, p. 1). Because of shrinking solution spaces (Haasnoot, Lawrence, and Magnan, 2021), coastal retreat is expected to become inevitable in many low-lying coastal areas around the globe. Migration, defined both as a national and cross-border phenomenon,¹ will be part of individuals’ and communities’ coastal adaptation strategies, next to strategies aiming at staying in current locations through enhanced protection and accommodation measures (Oppenheimer *et al.*, 2019). Nevertheless, in some cases, options for *in situ* adaptation are limited as they are not technically feasible or affordable, and moving away from the coast is or will be the only option left (Boege, 2016). Some countries particularly vulnerable to sea-level change (SLC) impacts are already planning medium- to long-term international relocation strategies, such as Vanuatu’s new National Policy on Climate Change and Disaster-Induced Displacement (Farbotko *et al.*, 2021), following the now defunct Kiribati’s “migration with dignity” policy (Curtain and Dornan, 2019). Even if this phenomenon remains minor in absolute terms (i.e. number of migrants), climate-induced coastal migration may trigger important transboundary consequences and highlights important ethical, humanitarian and governance questions at the global level. While it still makes sense to consider migration as a last resort strategy (once all other options are exhausted locally), and recognizing fundamental human rights especially related to migration, as well as place attachment, cultural heritage and the desire to stay home, we argue that there is a critical need to anticipate the potential for negative cascading consequences of migration across borders, for both migrant and hosting communities.

This is all the more critical as if such an adaptation option is chosen and if appropriate governance arrangements are put in place, migration can be a positive long-term adaptive strategy reducing migrants’ vulnerability to climate change (Gemenne and Blocher, 2017) and benefit hosting countries and communities. Migration has in many cases shown to contribute to the local economy, among other positive aspects (OECD, 2014). Migration should therefore not be considered as a risk in itself, even if it remains challenging in an era of hardening borders (McLeman, 2019) where climate migration may be seen as a “looming security issue” (Boas *et al.*, 2019) and populism is still on the rise (Ammar, 2018). Most research and policies (e.g. through National Adaptation Plans) currently focus on internal/national migration; cases of (forced) international migration are considered as a minor phenomenon, quantitatively speaking, although it is acknowledged as a major policy concern. The issue of coastal migration raises critical ethical and governance issues, independently of the figures of anticipated migration flows. At the same time, it has not been fully explored by the scientific community, so that some critical questions remain unanswered, such as: how many people will have to leave their homes in the coming decades, and how confident are the estimations? What may be the consequences of these movements (including transboundary cross-border effects)? Because of cascading effects, climate-related risks across borders could be more important than expected (Carter *et al.*, 2021, Adams *et al.*, 2021). For example, climate-change induced migration could represent a source of varying types of transboundary impacts, from socio-economic inequity and loss of culture to, when taken to its extreme, political instability and violent conflicts –even if this is relativized by recent research (Koubi, 2019).²

To date, there are no in-depth assessments of cascading risks related to coastal migration across borders. The vast majority of studies focus on observed migration drivers (Why and how

¹ “Migration: The movement of persons away from their place of usual residence, either across an international border or within a State.” IOM Glossary of Migration 2019.

² This more broadly refers to many cascading effects such as pressure in both countries of origin and destination areas on land availability, ecosystem services, job markets, impoverishment, dislocation of communities, changes in remittance patterns, etc.

do people migrate?), but very few address the potential consequences and related adaptation strategies at a regional/international level (What are they and how do they interact? How to minimize related risks?). Even though some studies develop projections on future trends in migration flows (e.g. Lincke and Hinkel, 2021), they barely highlight specifically the proportion of movement across national borders, nor question the future cascading implications of such transboundary consequences on both the migrant and hosting communities. This creates a major gap: although migration is considered, there is little work on how to prepare for it and what governance arrangements are needed to facilitate such migration and avoid possible maladaptation in both the countries of origin and destination.

Considering these elements, this study uses the case of coastal migration as an entry point to bring new elements into the debate on managing transboundary climate risks. It explores the following questions: why and how is coastal migration happening? How can transboundary adaptation strategies minimize negative impacts or maladaptation (and henceforth support positive outcomes)? What are the key actions to be undertaken to anticipate, prepare and facilitate such flows? What are the existing policy frameworks or those to be strengthened? And how to sequence them over time, from now to the longer term?

We aim to discuss how national decisions in terms of the protection of human assets (settlements, infrastructure, subsistence and economic activities) and transboundary governance of human mobility (incentives/barriers) could tackle part of the consequences induced by migration flows across borders, and therefore result in positive implications on vulnerability and risks globally. Accordingly, this study identifies five policy pillars to support viable conditions and options for climate adaptation-compatible migration: (i) implementation of ambitious global mitigation and international support for adaptation; (ii) effective national to local coastal risk reduction policies; (iii) development of robust migration policies that would allow to plan for the movement of people across borders; (iv) enhancement of hosting conditions; and (v) participatory measures to ensure the empowerment of communities and individuals, through preparedness and right to decide. These five pillars are interdependent, as action can either stall or reinforce interlinked components. As a result, their implementation in a sequenced manner appears to be one of the best ways to consider migration as an effective adaptation strategy in the face of climate change and sea-level change. The post-Covid 19 recovery will be a key period of redefining coastal futures, and innovative research and policy dialogue could help enhance better adaptation at all scales (local, regional, international).

This study first provides a state of the art on coastal migration knowledge, highlighting current knowns and unknowns on this subject (sections 2 and 3); then it develops an "adaptation pathways" approach bringing the above five policy pillars together (section 4).

2. MATERIAL AND METHOD

2.1. General approach

This study has been developed between January and July 2021. It is first based upon a desk review and assessment of existing scientific and grey literature. About 200 studies have been considered dealing with the topics of coastal impacts, coastal migration, climate migration and sea-level rise. For each paper, information has been gathered on the types of coastal hazard/risk considered, location and region, scale of analysis, climate-related and anthropogenic drivers associated with migration, observed and projected migration patterns and trends, and potential cascading effects.

In addition to the literature review, semi-structured interviews were conducted between April and May 2021 with 14 international experts on coastal risks and migration (listed in the Acknowledgements). The questions that guided the interviews (see Supplementary Material SM1 for details) aimed at understanding deeper transboundary risks related to coastal migration (main cascading effects; underlying risks across borders; and main factors of influence explaining the nature and extent of these cascading consequences), the triggers of transboundary risks (limiting/aggravating factors, spatial patterns, potential thresholds and timing) and how to manage cascading risks. This framing allowed us to test our main hypotheses with external experts, i.e.:

- (i) Focusing mostly on international migration, we consider that SLC-related migration is already a reality, even if minor in terms of the number of individuals concerned, compared to internal migration, and its transboundary impacts are a blind spot of adaptation policies and current research;
- (ii) Disturbed sea-level change-driven migration patterns could entail unanticipated types of transboundary risks;
- (iii) Current coastal migration scenarios might have been underrated due to conservative, linear parameters of projections or historical/current observations (and/or other factors).

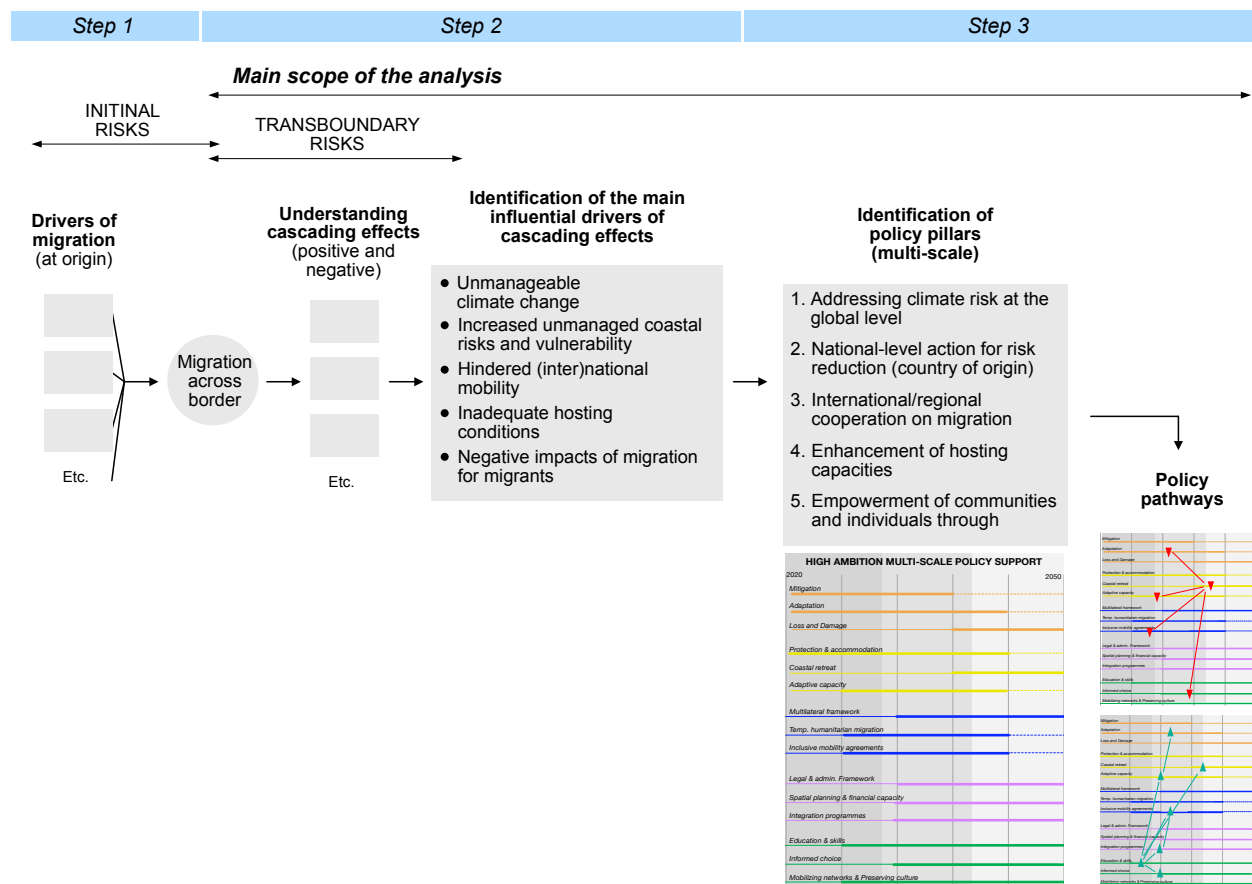
2.2. Building policy pathways

One important challenge for this study was to be able to move from the identification of main influential factors of cascading effects from transboundary climate migration to organized policy pathways, in order to support decision-making at multiple scales. The approach relied on the literature review, the expert interviews and the authors' own expertise. It followed a 3-step approach (Fig. 1).

Step 1 consisted, as mentioned above, in the identification of the climate-related coastal migration context, including drivers and patterns (left-hand side panel of Fig. 1);

Based on this, Step 2 consisted in understanding the multiple cascading effects of coastal-induced migration across borders (central panel of Fig. 1). Discussions with external experts and insights from the literature helped highlighting five main

FIGURE 1. Methodological approach to the design of policy pathways to address the cascading effects of coastal migration across borders.



influential factors: unmanageable climate change (global scale), increased unmanaged coastal risk and vulnerability (in areas of origin of the migrants), hindered (inter)national mobility, inadequate hosting conditions in areas of destination, and the negative impacts of migration for migrant communities and individuals. Once identified, the authors asked the experts initially interviewed to check the results and provide further comments and guidance;

Last, Step 3 consisted for the authors in joining a two-day workshop in order to identify the main policy pillars to tackle the above influential factors (see right-hand side panel in Fig. 1, as well as connections in Fig. 2); their respective timeframes of development (including the design, implementation and follow-up phases) between now and mid-century; and some of their positive and negative influences. Timeframes for design, implementation and follow-up have been established collectively using scattered information in the literature and some insights from the expert interviews, but mainly the authors' own expertise on national-, regional- and international-level policy mechanisms and frameworks. The assessment of the timeframes of development of each of the fifteen policy pillars identified in the study laid the foundation for the design of a generic policy pathway describing a high ambition multi-scale policy support

(see Fig. 4). This latter then served as background material to understand positive and negative interdependencies across the policy pillars. To highlight such interdependencies, the authors focused on two examples of positive and negative influences, respectively (see Fig. 5). Given the huge knowledge gap on such interdependencies in the scientific and grey literature, this very last step mainly relied on the authors' own expertise.

The outcomes of Step 1 are described in sections 2 and 3, and the outcomes of Steps 3 and 4 are described in section 4.

3. FRAMING COASTAL MIGRATION

Coastal communities around the world are expected to encounter increasing pressure from sea-level changes (SLC, i.e. rise in mean sea levels and changes in climate variability) and the general expectation for the coming decades is that people's migration toward the coast will slow or reverse in many places. This might however prove wrong. Migration factors are complex and mobility responses are not forced directly by the physical impacts of SLR, so that there remain uncertainties around the future direction of migration flows. Before discussing transboundary risks related to coastal migration, it is important to

identify the drivers of migration (national or beyond borders), the potential future hotspots of migration, and the policy mechanisms at stake in individuals' and communities' decision to migrate. These elements are essential for a comprehensive understanding of the issue and, therefore, the identification of policy pillars for minimizing maladaptive outcomes of coastal migration across borders.

3.1. The coastal paradox

Coastal areas already experience and will increasingly be affected by sea-level changes, including a rise in mean sea levels and modifications due to extreme events such as storms and associated surges, especially thorough temporary and permanent marine flooding. The latest projections of the IPCC anticipate a rise of global mean sea level between 0.43 and 0.84 meter by the end of this century relative to present day (reference period 1986-2005), and depending on global emission scenarios (Oppenheimer *et al.*, 2019). The upper likely range of the high emission scenario (RCP8.5) estimates a +1.1m rise by 2100, and a +2m rise cannot be excluded. In addition, climate projections show that we are committed to SLR well beyond 2100 (range from 0.6–1.1 m to 2.3–5.4 m by 2300 for RCP2.6 and RCP8.5, respectively; Oppenheimer *et al.*, 2019), raising the need for ambitious coastal adaptation strategies over the 21st century, and the potential for increasing coastal risks and possibly human migration from the coasts (Wrathall *et al.*, 2019; Horton *et al.*, 2021; Lincke and Hinkel, 2021). Moreover, SLR is not just about the slow-onset global rise of water levels: it has differentiated consequences across regions, and also induces increased consequences of climate extremes (storms, cyclones, etc.) and, eventually, an exacerbation of already experienced coastal hazards (marine flooding, shoreline fluctuations, and soils and groundwater salinization). These changes are putting coastal settlements and livelihoods under increasing risks. The expected loss caused by SLR impacts in terms of global GDP could range between 0.11-4.5% by the year 2200 (Desmet *et al.*, 2018).

Coastal climate-related risks will vary locally depending on the geographic location, specific physical impacts, socio-economic context, demographics, etc. This implies differentiated impacts, vulnerabilities and coping capacities, and hence differentiated adaptation challenges and responses. A country such as the Netherlands, even if facing major pressure with rising sea levels, might be more in capacity to cope with the financial consequences of SLC compared to another country with fewer resources. Still, "in the absence of high adaptation (...), the additional coastal risks induced by SLR are expected to increase over this century in all low-lying coastal areas, whatever their physical setting (island or continental), location (...) and level of development" (Magnan *et al.*, 2021), with prominent risk escalation in Arctic communities and Urban Atoll Islands even in strong mitigation scenarios (Duvat *et al.*, 2021).

Cities are major hotspots for future SLC impacts, especially in rapidly urbanizing coastal areas in developing countries or

least developed countries with potential for increased vulnerability (Oppenheimer *et al.*, 2019; Sterzel *et al.*, 2020). Over the last century, there has been an unprecedented growth in the size and populations of coastal cities; in 2007, 40% of the world's population was living in a narrow coastal band that takes up 7% of the earth's land area (McGranahan, Balk, and Anderson, 2007), and some coastal megacities like Shanghai or Sydney gather millions of inhabitants (27.7 and 5.3, respectively). This phenomenon has led to a radical transformation of coastal environments because of unmanaged population increase, urban expansion, and resource demand; resulting in "long-standing and emerging socio-economic and biophysical problems for coastal cities [which] are compounding because of the magnitude and acceleration of transitions" (Sterzel *et al.*, 2020, p.5). There are other contexts to consider, such as Small Island Developing States (SIDS), where there can be a negative feedback loop of constructing and gathering communities in coastal areas because of the focus of the local economy on tourism, creating dependence towards this sector for jobs and the local economy (Scott, Simpson, and Sim, 2012; Schmude *et al.*, 2018; Wright, Kelman, and Dodds, 2020).

This creates a "coastal paradox", especially for urban areas: there are increasing flows of in-migration to coastal zones (see for instance the cases of Fiji and Tuvalu in McMichael *et al.* (2021), or Bangladesh in Bell *et al.* (2021)), leading to more urban development, while coastal areas face aggravated levels of risk exposure because of SLR and might become increasingly subject to out-migration. The in- and out-migration movements can refer to different (groups of) populations, creating some phenomenon of "churning" (Curtis, Fussell, and DeWaard, 2015); still, the paradox remains at a local level. Some projections estimate that because of SLR, there might be some massive departures from the coasts, pushing millions of people away and thus reversing the current population trends (Myers and Kent, 1995; McGranahan, Balk, and Anderson, 2007; Wyett, 2014). However, recent research on coastal migration demonstrates that, as counterintuitive as it may seem, coastal zones will probably stay attractive in spite of increased levels of climate impacts, and migration is even projected to increase in at-risk zones (Bell *et al.*, 2021). For example, historical observations in Louisiana, USA, have shown that the relocation of parishes has been disconnected from the advance of SLR, while the territory has been losing 28 km² per year (Hauer *et al.*, 2019).

3.2. How many people could be concerned?

The reality of SLC raises growing concern about the safety of coastal populations. Recent estimations of the population that could be affected by 21st-century SLR range from 187 million (Vafeidis, 2011) to over 1 billion people (Neumann *et al.*, 2015), especially in Asia (UK Government Office for Sciences, 2011). A recent study estimates that these numbers might have been underestimated, stating that already one billion people now occupy land less than 10 m above current high tide lines,

including 230 million below 1 m (Kulp and Strauss, 2019).³ The impacts of SLR on at-risk coastal populations will be caused by an increase in frequency and intensity of extreme events (storms, cyclones, one-in-100-year flooding, etc.), causing brutal damage to coasts, sometimes breaching further inland (McLeman, 2018a). Slow-onset impacts such as gradual land erosion, recurrent nuisance flooding or, in some cases, permanent flooding are also important to consider (McLeman, 2018a). Still, in most cases, marine flooding will not be the first “push” factor compared to other impacts of SLR that could affect local livelihoods more rapidly, such as the degradation of water resources and soil capacities. For example, in Bangladesh, the corrosive effect of salinity on local agricultural economies could displace up to 200,000 people from the coasts because of the reduction of rice yield (Chen and Mueller, 2018).

The number of additional people at risk from SLC should not be assimilated to the number of potentially displaced people. In fact, many people live under sea-level or close to the shoreline (Atoll Island States, the Netherlands) without necessarily already experiencing intolerable risks that could force migration. There are many limits in using the above models as indicators of the number of people susceptible to migrate in the coming century, starting by the confusion between *additional risk* (which might be tolerable) and *existential risk* making a place uninhabitable (see Adams, 2016; Handmer and Nalau, 2019; Duvat *et al.*, 2021), the level of acceptable risks ultimately depending on various cultural perceptions of risk and perspectives (McMichael, Farbotko, and McNamara, 2019; Farbotko, 2019). These projections do *not* explicitly aim at estimating the number of potentially displaced people, even if they sometimes leave it unclear whether people at risk from SLR are potential migrants or not. In any case, all assertion mistaking the number of people at risk from SLC for the number of future migrants makes a major methodological mistake, which contributes to reinforcing a “false narrative that predicts large numbers of ‘climate refugees’ (...), entrenching climate migration as a looming security crisis without an empirical scientific basis” (Boas *et al.*, 2019, p. 902).

Recent studies focusing on coastal migration have provided more nuanced results, estimating the number of coastal migrants caused by SLC up to 17-72 million people until 2100, depending on different socio-economic and mitigation scenarios (Lincke and Hinkel, 2021). Another study predicts up to 1.46% of the world’s coastal population could be displaced in 2200 (Desmet *et al.*, 2018). There are still some major gaps in research on coastal migration projections, starting with the lack of regional empirical data (Hauer, Evans, and Mishra, 2016). There are still large margins of uncertainties because the number of migrants will also depend on individuals’ level of agency and on the governance of coastal migration in the coming decades (see sections 3 and 4).

3.3. Where will people come from and where will they go?

It is estimated that large countries in South and South-east Asia will be hotspots of coastal *out*-migration in absolute terms, while in relative terms Small Island Nations may be the most affected in terms of the percentage of population (UK Government Office for Sciences, 2011; Neumann *et al.*, 2015; Lincke and Hinkel, 2021). There is also considerable agreement within the scientific community, and despite few empirical studies, on the fact that most of the migration flows will remain internal (*relocation*) or regional, whether temporary, like after extreme events such as Hurricane Maria in the Caribbean region (Meléndez and Hinojosa, 2017), indefinite, voluntary or forced (see McLeman *et al.*, 2021). There remains a lack of data on climate migration and migrants because of the complexity of mobility drivers—people rarely leave only for environmental reasons, although it might become more frequent under greater climate pressure in the future. Moreover, in most countries environmental migrants are registered as “economic migrants” in national reporting processes, which complicates data collection.

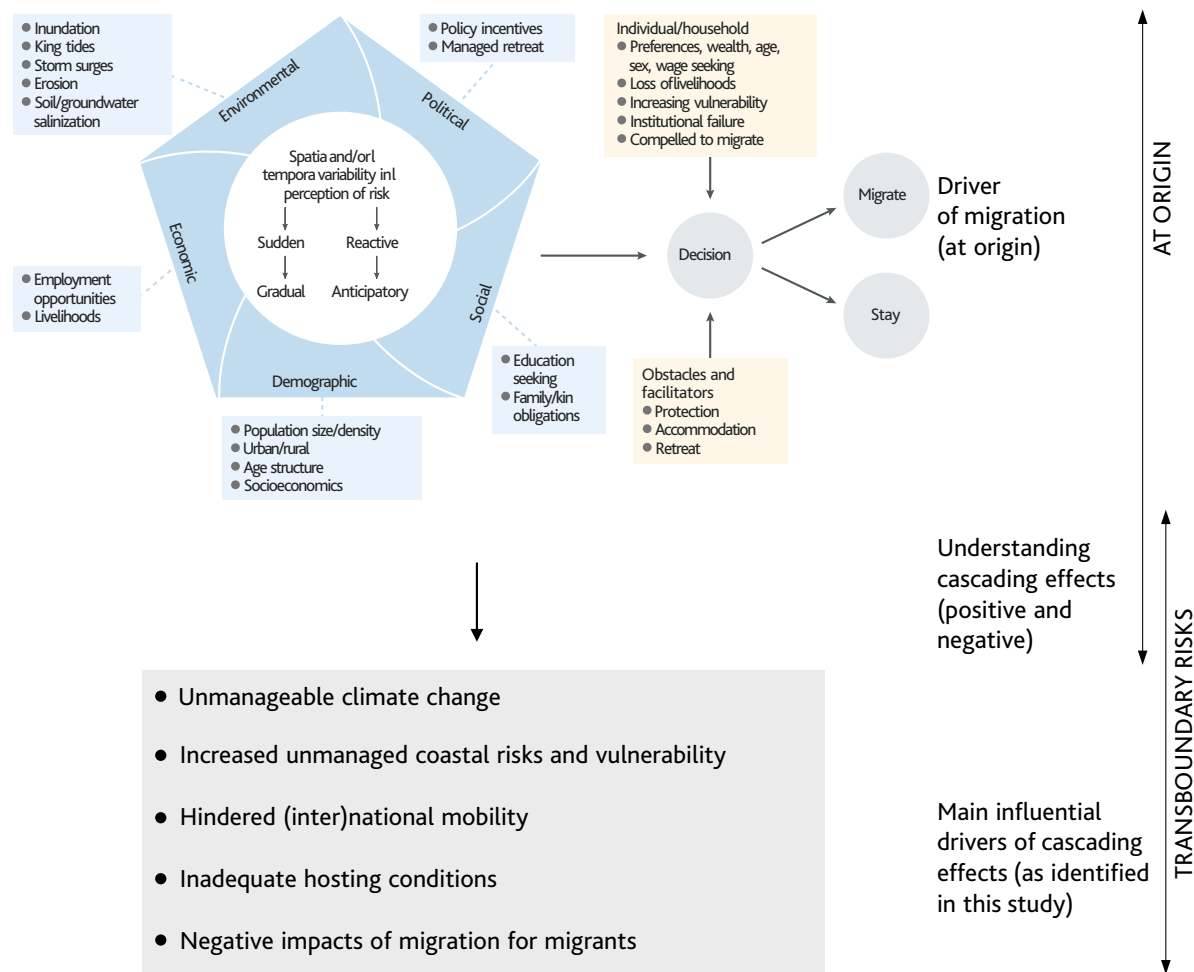
The most probable scenario is that SLC will influence “the timing and volume of ongoing migration, rather than produce new patterns of migration without historical precedent” (Wrathall *et al.*, 2019, p. 898). For the next generations, there will probably be an increase in existing migration flows as the presence of a diaspora is a well-known facilitating factor (Curtain and Dornan, 2019). Still, it is difficult to model migration destinations in the longer term as new schemes might emerge, depending on opportunities, bilateral and multilateral policy agreements and mutual benefits. Models trying to assess the destination of potentially displaced persons and national projections are starting to look at the impacts of these displacements (Hauer, Evans, and Mishra, 2016); but no initiative has been established at a larger scale. Considering these aspects, it is likely that SLC will lead to increased flows of out-migration from less populated, marginalized coastal areas (rural areas, villages, Small Island States, Arctic communities), while bigger cities having the resources to protect themselves will remain economically attractive and will capture an important share of in-migration flows. This scenario could lead to “bifurcating coastal futures” (OECD 2019) with increased levels of risks for vulnerable communities. It may then raise major ethical concerns in terms of equity and climate justice, especially if vulnerable populations find themselves “trapped” (see p. 14).

3.4. Towards bifurcating coastal futures?

During the 21st century, the world is likely to see bifurcating coastal futures (OECD, 2019), in line with recent IPCC conclusions (Oppenheimer *et al.*, 2019). As stated by Lincke *et al.* for instance, “on the one hand, the grand majority of coastal inhabitants, which lives in densely-populated and urban coastal areas, is likely to continue to protect themselves even under high-end sea-level rise (...). On the other hand, poorer rural areas will

³ This estimate does not take current or future defences into account.

FIGURE 2. Schematic view of the factors influencing migration outcomes under conditions of SLR (left-hand side) and main influential drivers of cascading effects across borders (right-hand side).



Source (left-hand side): Hauer *et al.* (2020).

struggle to maintain safe human settlements and are likely to eventually retreat from the coast. (...) As migration cannot always be within country borders, international issues might arise" (Lincke *et al.*; 2021, p. 15)."

Current research points to the lack of data regarding SLR impacts on human mobility in the longer term because of major uncertainties in empirical observations and models of projection (see section 3). Migration is a complex phenomenon (Fig. 2), and it is not the only strategy that can be adopted facing SLC. While "it is often assumed that direct inundation forces a migration, (...) mobility responses are instead driven by a diversity of socioeconomic and demographic factors, which, in some cases, do not result in a migration response" (Hauer *et al.*, 2020, p.1). In other words, not all people will adopt out-migration as a response to SLC impacts. And for those who will, it is the "pressures at home and perceived benefits and risks associated with migration [which] ultimately determine whether an individual or household member migrates" (Curtain and Dornan, 2019, p. 1). These choices take into account many factors, and without denying the real and

legitimate fears of some migrants, which are an impetus, more work is needed to understand how migrants balance fears and hopes in their decisions to risk their well-being, families and sometimes lives when reaching and settling in a destination country (Kelman and Stojanov, 2020). Coordinated policies to support voluntary choices as well as safe travels and landing are critical and will continue to be, as hypothesized later in this study (section 4). Such policies could contribute to address the need for a balanced assessment of opportunities as well as risks to avoid sustaining some partial representations of migration, where "fears in destination locations might (...) transcend into (unjustified) fears of the migrants who are presumed to bring crime and disease or to take over the destination's culture and values", thus leading to xenophobia and rejection (*ibid*). Some people will make the choice not to migrate or will be unable to do so, because of a lack of agency or a strong feeling of place attachment (Farbotko, Stratford, and Lazrus, 2016). The concept of "trapped populations" (Ayeb-Karlsson, Smith, and Kniveton, 2018; Zickgraf, 2019), also framed by some researchers as "moored populations" (Bell *et al.*, 2021) or

"immobile populations" (Adams, 2016), has emerged to refer to such a category of people at risk but not able to adapt nor move (see section 3).

Coastal migration drivers stem from three types of factors:

- Physical risks (coastal impacts, disasters, increased pressure from sea-level change);
- Individual/household degree of agency (mobility capabilities, social network and diaspora, education, gender, age, etc.);
- Governance (obstacles and facilitators, such as visas delivery procedures or labour agreements).

Governance plays a crucial yet under-studied role in migration processes, as "climate migration" drivers are often framed in terms of individual/household agency and sub-national migration. There is a need to better assess the role of policies, from local adaptation and coastal protection to international cooperation on migration, in the governance of transboundary mobility. The case of Pacific islands, which are ahead in tackling the topic of climate and disaster related mobilities, "may prove useful to nations or regions also grappling with how to approach climate-related human mobility (or immobility) as a policy concern" (Farbotko *et al.*, 2021, p. 2).

How can improved research help in anticipating such events (section 3)? And what would be the main areas of actions to undertake in order to either facilitate migration as a chosen and beneficial adaptation strategy, or indirectly encourage forced (im)mobility and associated cascading risks (section 4)?

4. KNOWN AND UNKNOWN ON COASTAL MIGRATION AND RELATED IMPACTS

The future of coastal populations is a concern for both the scientific and policy arenas. There are however large uncertainties on the volumes and timing of future migrations in a warmer world with rapidly rising sea levels, and no historical analogues can be found at this scale. This section highlights the current knowns and unknowns about future risks and their cascading, transboundary potential effects.

4.1. Current empirical observations: dealing with major lack of analogues

Observations of past or present impacts of sea-level changes on movements of coastal populations allow for insights on the current situation. Yet it has limited use when trying to project what may happen in the coming decades or centuries, because of:

- *A lack of knowledge on migration destinations and impacts:* an important part of actual literature on climate migration is based upon field observations, mostly through questionnaires, in order to get a sense of migrants' trajectories and factors of choice in their decision to migrate (Entzinger, Jäger, and Gemenne, 2010; Obokata, Veronis, and McLeman,

2014; Cattaneo *et al.*, 2019; Kaczan and Orgill-Meyer, 2020). Yet "the behavioural dynamics of SLR migrants needs greater attention, with a focus on the potential destinations of these migrants" (Hauer *et al.*, 2020, p. 7). Most of these studies focus on migration drivers (asking why and how do people migrate) and internal migration;

- *The quasi absence of historical (contemporary) analogues,* except for some very specific and limited cases, as Chesapeake Island (Gibbons and Nicholls, 2006) or the Banabans (McAdam 2017). To date, there is no documented case of a coastal country having to abandon a whole part of its littoral except for these exceptional insular cases, where the population's departure was not even driven by SLC but other motives such as anthropogenic activities (e.g. industrial mining) that have impacted coastal areas. Even if data from historical analogues was available, "they may not be appropriate predictors of the future or serviceable in predictions across contexts, given the magnitude of projected SLC impacts" (Bell *et al.*, 2021, p. 7).

4.2 Projections and models

A significant part of coastal migration studies relies upon modelling (agent-based models, cost-benefit analysis), in order to project collective or individual choices facing increased environmental pressure linked with SLC (e.g. Nicholls, 2011; UK Government Office for Sciences, 2011; Strauss, Kulp, and Levermann, 2015; Bell *et al.*, 2021; Lincke and Hinkel, 2021). However, these projections focus on the number of people potentially displaced or at risk, rather than on the consequences these displacements may have upon other territories. A few studies have looked at the topic of population redistribution under the influence of SLC, but mostly at a national scale (Hauer, 2017). The consequences of coastal migration could also have cascading impacts (Carter *et al.*, 2021) for more people than the migrants as such, making it all the more difficult to quantify the global number of people affected by SLR-related cascading impacts of human movements. Taking into consideration the vast range of possible situations, the main risks related to coastal migration lie in aggravated inequalities. This also means there are increased difficulties to predict the number of future coastal migrants, notably because of three factors of uncertainty:

- The importance and long-term effectiveness of coastal protection (especially for densely populated areas) (3.2.1);
- The existence of (un)wanted immobility (3.2.2);
- And the vast uncertainties remaining on the range of impacts, depending on the climate and development scenarios, but also on the dynamics of migration, if some physical or human "thresholds" are reached (3.2.3).

4.2.1 Coastal protection (and/or accommodation) will be preferred over displacement, especially in the most populated and wealthy coastal areas

Displacement might not be the most common option in the most populated and wealthy coastal areas, thereby prioritizing

protection and/or accommodation. According to a recent study, 78% of the global coastal population and 92% of global coastal floodplain assets will be protected over all scenarios of SLR (Lincke and Hinkel, 2021). According to the OECD, "the large majority of coastal inhabitants live in densely populated urban coastal areas, and are likely to continue to protect themselves even under high-end sea-level rise due to the high cost-benefit ratios of coastal protection in these areas" (OECD, 2019, p.2); and where high concentrations of assets and people are present at the coast, we are likely to see increased protection, rather than large-scale damages (OECD, 2019). Observations have shown the resilience of most cities facing erosion and rising sea levels, like Tokyo, Japan, and evidence indicates that new lines of defence will be built further into the water, effectively meaning that humans will probably encroach on the sea (Esteban *et al.*, 2020). Many cities are already planning for resilient adaptation strategies, such as New York, USA ('Lower Manhattan Climate Resilience Study', 2019).

However, some barriers could undermine the efficiency of this option: physical, financial and technological limits might dissuade coastal protection, raising the question of "just resilience" (Lager *et al.*, 2021; Miller, 2020), environmental justice (Colten, 2007) and loss and damage (McNamara *et al.*, 2018a). The recent choice of Jakarta to move 100 miles away is a telling case (Van de Vurst and Escobar, 2020) showing that difficult choices might have to be made, especially in developing and least developed countries. Other territories at risk are already facing the same perspective, leaving their inhabitants with the heavy burden of deciding for how long they can artificially extend the life of their village, like the community of Jean Lafitte in Louisiana, USA, that is facing rising seas, subsidence and erosion of habitable land (Sack and Schwartz, 2018). The question of financing coastal adaptation raises a number of challenges, due to the nature of coastal protection as a public good (OECD, 2019). Moreover, residual risks remain and coastal protection might create a paradoxical "safe development" perception, thus increasing the density of construction behind dikes; if coastal protection is insufficient or maladapted, this could lead to human catastrophes such as what happened in New Orleans, USA, with Hurricane Katrina in 2005 (Burby, 2006). The memory of past flood disasters might as well decay over time while population keeps growing in coastal areas, creating a "failed-levee effect", as shown by some large-scale analysis in the USA (Collenteur *et al.*, 2015). In other words, coastal risks remain despite coastal protection measures in place, and protection will not completely eradicate coastal retreat options (Haasnoot, Lawrence, and Magnan, 2021).

4.2.2 Not all people facing existential risks because of SLR will want and/or be able to move

There is also a case to be made for immobile populations and (un)voluntary immobility (see part 2). According to a recent study, by 2030, around 64% of I-Kiribati adults aged 20-44 years, 47% of Tuvaluan adults and 10% of Nauruan adults

will want to migrate but be unable to do so (Oakes, 2019).⁴ The gradual or sudden degradation of assets (land, housing, production, agricultural yield, etc.) because of SLR impacts might particularly affect fragile populations or individuals, making adaptive migration outside of their economic capacities (Wrathall *et al.*, 2019). In some cases, paradoxically, even the granting of public credits might encourage people to remain "moored" into at-risk places, in order to preserve their housing and remaining assets (Bell *et al.*, 2021).

Moreover, migration strategies—especially if trans-boundary—rely on various factors, including age, gender, education and social network, potentially leading to discrimination in terms of mobility capabilities (Millington, 2000; Hunter and David, 2009; Drabo and Mbaye, 2015). Factors such as place attachment (Adams, 2016b), coastal culture and risk tolerance might also play a role in the immobility of some coastal populations facing increased pressure from SLC. This creates an "immobility paradox": many people do not want to move, and will favor a "holding the line" approach rather than relocating (Simms, 2017).

4.2.3 Thresholds, tipping points and uncertainties on the range of impacts

Finally, current coastal migration scenarios might have been underrated due to conservative, linear parameters of projections and other factors, such as the lack of scientific data, but also eventual political/diplomatic reluctances to discuss this topic. The risks might have been underestimated and, even if they have not been observed at a larger scale for the moment, they could spread if some tipping points are surpassed—especially in scenarios of maladaptation/unpreparedness. Moreover, most projections for physical risks are based upon a linear approach, considering a 2°C temperature rise (the range of uncertainties being too important above this level of global temperature rise). Yet in the event of a greater warming, "not only is it likely that climate-induced population movements will be more considerable, but also their patterns could be significantly different" (Gemenne, 2011, p. 2).

In other words, the surpassing of some physical thresholds could influence human thresholds in terms of risk tolerance, and thus influence mobility choices and migration patterns. Migration and displacement may begin as incremental changes in existing migration patterns, but research on past environmental migration and settlement abandonment indicates that critical thresholds exist in mobility patterns that, once crossed, cause population movements to accelerate in a nonlinear fashion (McLeman, 2018b; Hauer *et al.*, 2019). In the same perspective, regarding the current predominance of regional and internal migration, there is a question to be raised on the limits to local migration, especially due to physical limitations and socio-political factors, leading to increased pressure on landlocked areas (Hauer, 2017) and *coastal squeeze* (Doody, 2004). SLR-driven

⁴ Note: these figures do not account for the elderly and children.

mobility could thus follow non-linear pathways of risks and have unanticipated impacts (Streets and Glantz, 2000). This seems to be confirmed by advances in modelling of ice sheets and more precise estimations of populations at risk (Kulp and Strauss, 2019). These kinds of “pessimistic” scenarios should be considered, in view of the actual pathway of GHG emissions and associated warming (Oloff and Christensen, 2020), as the Western Arctic ice sheet might already have crossed a tipping point (Boers and Rypdal, 2021). The current “adaptation gap” (UNEP, 2021) and growing inequities in the wake of Covid-19 pandemic (Josephson, Kilic, and Michler, 2021; Sumner, Hoy, and Ortiz-Juarez, 2020) could also add supplementary pressure on climate and impacts and narrow the range of future options, if not tackled now.

Disturbed SLR-driven migration patterns could then entail unanticipated types of transboundary risks. There is therefore a need to shift perspectives and re-think adaptation strategies through the prism of cascading risks and transboundary climate impacts. Governance strategies have to take into account the main influential factors upon which action can be undertaken (Section 4), in order to develop a polycentric model of cooperation (Ostrom, 2010; Aligica and Tarko, 2012) enabling all actors to get the scale of change in perspective.

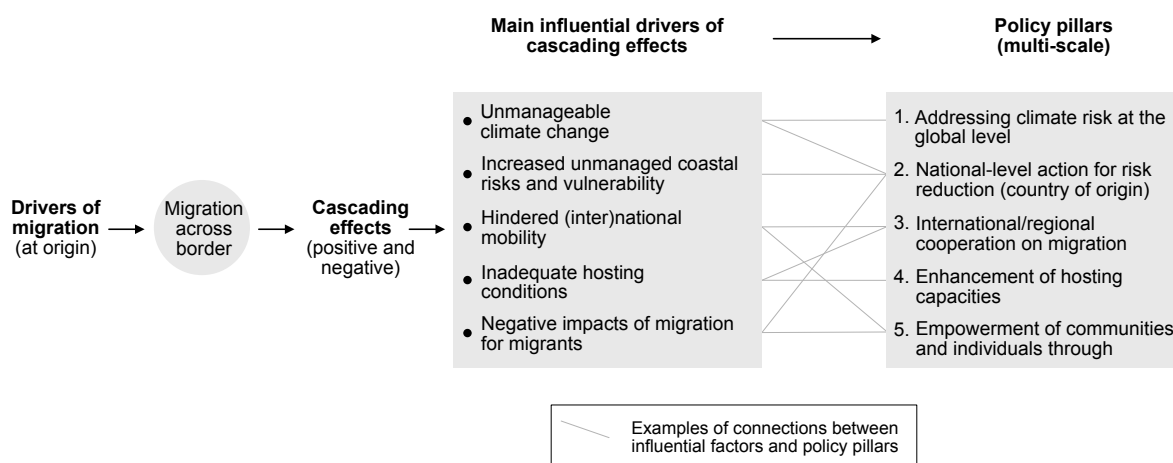
5. TOWARDS ADAPTATION POLICY PATHWAYS FOR COASTAL MIGRATION: WHAT CAN BE DONE AND WHEN?

To date, no clear understanding of coastal migration trajectories across borders and associated consequences, whether positive or negative, has been undertaken, while climate and SLC projections make this an increasing concern worldwide, as discussed in the previous sections. Here we propose an overview on the main

influential factors that could trigger some cascading consequences related with transboundary coastal migration (Fig. 2). In doing so, we argue that the extent and nature of the potential cascading impacts (negative or positive) will critically depend on the design of policies and governance arrangements to coordinate across scales (international, regional and national-to-local communities) to tackle these influential factors, and at the same time a forward-looking approach is critical to robust decision-making and cooperation. Together, these factors contribute to explaining the balance between positive and negative cascading effects. That is to say, the future of coastal migration will depend upon how the main influential factors of cascading risks are managed at different scales (Fig. 3), and upon the related policy pillars and adaptation pathways (Fig. 4, Fig. 5). This is why there is a need for a more detailed and balanced assessment of risks, in order to better enhance preparedness, resilience and planned transition towards a polycentric governance of coastal migration, and of climate adaptation more broadly.

This pathway approach aims at exploring policy options to help anticipate and prepare for migration. The roadmap in Figure 4 gathers the above-mentioned five policy pillars under a high ambition scenario to illustrate a sequencing of policy-supporting processes coordinated across scales in order to better prepare for SLC-related migration. It is important to note a few points on the design of this policy pathway: firstly, the roadmap was designed with careful attention to synergies across policy pillars, in order to ensure optimization of policy processes across scales and timeframes. On account of these interdependencies, some supporting policy processes are in first order, because they reinforce and accelerate others or if delayed can culminate in substantial setbacks. Secondly, the roadmap does not aim at establishing a hierarchy among the policy pillars, and instead considers them as equally important and complementary processes. Thirdly, the exercise aims to be exploratory using a given scenario of high ambition. To

FIGURE 3. From identifying the main influential factors of migration across borders' cascading risks to multi-scale policy pillars.



this purpose, it is not prescriptive. The overall objective is to help visualize the issues and eventual sticking points, in order to foster dialogue and cooperation between relevant actors. The sub-sections below describe the policy pillars and their inter-relatedness. Figure 4 moves a step further by illustrating influences among policy pillars and highlighting positive and negative interdependencies.

5.1 Policy Pillar n°1: Addressing climate risks at the global level

5.1.1 Factors of influence: unmanageable climate change

Unmanageable climate change (Fig. 3) is one of the main factors to influence sea-level change, including accelerating sea-level rise, changes in climate extreme climatology, compound events and the reaching of tipping points (Oppenheimer *et al.*, 2019). It thus refers to the level of *physical hazards* coastal populations will face in the coming decades and centuries. In addition, *insufficient adaptation efforts* worldwide to tackle anthropogenic drivers of risk such as, for example, increased population and asset density in risk-prone coastal areas will result in a relatively high increase in exposure and vulnerability of the coastal populations at the global scale. Even under enhanced mitigation and adaptation efforts, scientific research suggests a possibility for increased *residual risks*, i.e. when adaptation limits are being reached (Handmer and Nalau, 2019; Oppenheimer *et al.*, 2019; Magnan *et al.*, 2021).

5.1.2 Policy-supporting processes: implementation of ambitious mitigation and international support to adaptation

The management of this policy pillar (i.e. addressing climate risks at the global level) sets the scenario around levels of risk with a focus on SLC. It deals with adaptation and mitigation at the global level, therefore laying some foundations for addressing the magnitude and temporality of migration patterns in the future. The main policy-supporting processes available for the international community to address climate risks related to coastal areas globally are *enhanced mitigation efforts* (P1), *increased adaptation support* (P2) and *loss and damage related to coastal migration* (P3).

(P1) Enhanced mitigation efforts refer for example to reaching global net-zero emission targets. As noted by Kulp and colleagues (Strauss, Kulp, and Levermann, 2015, p. 8) in the context of the USA: "For unabated climate change, we find that land that is home to more than 20 million people is implicated and is widely distributed among different states and coasts. (...) Under aggressive carbon cuts, more than half of these municipalities would avoid this commitment if the West Antarctic Ice Sheet remains stable." The magnitude of physical impacts should thus be considered as one of the cornerstones of any risk reduction policy with regards to the transboundary impacts of coastal migration. Mitigation policies are already partially in place (in Fig. 3, thick orange

line starting from now⁵), but there is a need to raise ambition to keep the global level of warming well below 1.5°C (IPCC, 2021). In the coming decades, these policies will have to be maintained and re-evaluated within the UNFCCC framework, especially given pledges in the Paris Agreement (in Fig. 4, dotted orange line).

The impacts of SLC are already being felt and the coastal zones will face shrinking solution spaces even in low-emission scenarios because of long-term and irreversible SLC impacts (Haasnoot, Lawrence, and Magnan, 2021). This is why there is a need for **(P2) increased adaptation support** globally, especially through enhancing effective adaptation finance, sharing experience on tackling transboundary and local climate risks, raising ambition in National Adaptation Plans (NAPs), and addressing international scientific knowledge gaps on cascading impacts and tipping points. The implementation of adaptation (thick orange line in Fig. 4), as a continual process, involves relevant monitoring and evaluation frameworks (e.g. maintenance and reinforcement where needed) in order to ensure sustainable financing and to inform the scientific gap continually (dotted orange line in Fig. 4).

Even under high ambition on both mitigation and global-level adaptation support, residual risks are expected to occur. As a result, **(P3) Loss and Damage related to coastal migration** will also have to be considered in international climate policy, notably through the UNFCCC Warsaw International Mechanism (WIM) Task Force on Displacement and relevant insurance mechanisms. In a high-ambition scenario, the negotiations under the UNFCCC WIM would continue and pave the way towards integrating residual risks and transboundary cascading impacts of climate change in national adaptation and mitigation policies as well as in multilateral agreements.

5.2 Policy Pillar n°2: National-level action for risk reduction (country of origin)

5.2.1 Factors of influence: increased unmanaged coastal risks and vulnerability

National planning for risk reduction could play a role in future mobility patterns (internal and transboundary), as national-to-local adaptation action will partly determine the habitability conditions of coastal areas, along with the levels of physical hazards and vulnerability (Fig. 3). This directly interacts with P1 (hereafter, policy pillars 1-5 will be referred to as P1, P2, etc.). First, there can be risks related to the degradation of "habitability pillars" (Duvat *et al.*, 2021), such as loss of land and ecosystem services, livelihoods, food and freshwater resources, healthy

⁵ Here we highlight connections between the text and the pathways displayed in Figures 3 and 4. We provide such guidance for the first policy pillars in order to guide the readers, but not for all policy pillars in order to avoid making the text cumbersome.

conditions, etc.; partly fueled by continued concentration of people, buildings and infrastructure in increasingly risk-prone areas, especially in urban zones (Sterzel et al., 2020). These risks could lead to increasing levels of vulnerability and eventually intolerable risk levels. Therefore, unmanaged socio-physical impacts could lead to (forced) migration in some cases, especially when in situ adaptation fails (McLeman, 2018b). Another type of risk relates to the phenomena of "climate gentrification" of some coastal areas (especially urban, see Keenan, Hill, and Gumber (2018)), along with the lowering priority on adaptation policies for marginalized and poorer coastal zones. This could lead to increasing discrimination of vulnerable populations unable or unwilling to move (see section 3.2).

5.2.2 Policy-supporting processes

National-scale action is thus crucial to anticipate and reduce future risks related to coastal migration. National policies for coastal migration-related risk reduction can mainly focus on three aspects: *enhance coastal protection and accommodation* (P4), *prepare for coastal retreat* (P5) and *build adaptive capacity* (P6).

(P4) protection and accommodation (respectively hard defence and nature-based solutions; and changing crop and economic activities, early warning systems, etc.) can be implemented or improved when relevant (thick yellow line in Fig. 4). Some priorities should be made towards protection and accommodation in areas where staying on the coast may appear the best option for the decades to come, especially in densely populated areas, locations with key infrastructures (e.g. international airport) and cultural heritage sites. The maintenance phase (dotted yellow line in Fig. 4) will then involve maintenance and reinforcement (e.g. reinforcement of sea walls), including adaptation finance (see P2).

(P5) Preparing for coastal retreat is an emerging issue but it involves many political and ethical issues, such as the management of displaced people, the efforts for taking into account culture, place-based attachment and human rights, as well as land rights and compensation mechanisms (McAdam and Ferris, 2015; Doberstein and Tadgell, 2015; Boege, 2016; Koslov, 2016; McNamara et al., 2018b; Albert et al., 2018; Farbotko et al., 2021). Therefore, some urgent preparatory work (thin yellow line in Fig. 4) is called for in order to design robust and operational policies to support planned coastal retreat (e.g. involving the communities, raising awareness about climate change risks and crafting adapted opportunities for relocating). Currently, "resettlement as climate change adaptation is a developing concept, with minimal guidelines and academic literature on the topic" (Tadgell, Doberstein, and Mortsch, 2018, p. 201). Considering shrinking solution spaces for coastal protection and accommodation (Haasnoot, Lawrence, and Magnan, 2021), this set of policy options should thus be anticipated rapidly, and ensure the participation of communities in the co-construction of eventual relocation solutions (see P14; see Fig. 5).

Finally, there is a need to **(P6) build adaptive capacity** in order to enhance the resilience of natural and human systems through economic diversification, social protection, environmental protection, risk culture, etc. These actions would support sustainable development pathways (climate risk informed planning) across key areas: social, economic (through diversifying climate-sensitive economic activities), education, health and more. Even if there is an urgent need to translate these goals into action rapidly, the policies would be ready in the years to come (thin yellow line in Fig. 4) and could help support some communities to stay in place when possible and support some adaptive, beneficial opportunities for migration or relocation. Building adaptive capacities is also directly linked to education and training (P13), as well as communities' empowerment (P14); these dynamics, if implemented together, could strongly reinforce each other, rather than adopting a top-down approach of adaptation issues (Fig. 5).

These policies shape a governance framework aimed at enhancing participatory decision-making processes and access to appropriate information on risks, to land, to economic resources and judicial processes. This would allow for locally-tailored solutions to be implemented on time, and facilitate prepared migration.

5.3 Policy Pillar n°3: International and regional cooperation on migration

5.3.1 Factors of influence: hindered (inter-) national mobility

International and regional cooperation on climate-related mobility is an important pillar to be set in place as well and could result in both positive and negative feedback loops, depending upon the level of ambition (Fig. 5). A situation with insufficient international and regional cooperation mechanisms and frameworks on migration across national borders could result, in the most extreme cases, in *hindered international (or internal) mobility*—whether permanent or temporary. This situation could become particularly problematic for territories with reduced hosting capacities, such as Small Island States (the issue being different for coastal countries with vast territories, such as China, India or the USA). *Humanitarian catastrophes*, especially after extreme events and disasters, could also lead to regional and international cascading impacts if not managed through appropriate mechanisms, policies and agreements. A lack of cooperation on human mobility in a context of hardening borders, multiplication of "migration crises" (for example, in the EU in 2015) and the rise of populism could also trigger conflicts and *increased geopolitical pressure*.

5.3.2 Policy-supporting processes: Robust migration policies

Robust migration policies aim at planning for the movement of people across borders while reducing or avoiding cascading impacts of climate-related migration. In particular, this would provide the legal and policy building blocks for three main tools

FIGURE 4. A high ambition policy pathway scenario for managing the cascading effects of coastal migration across borders.

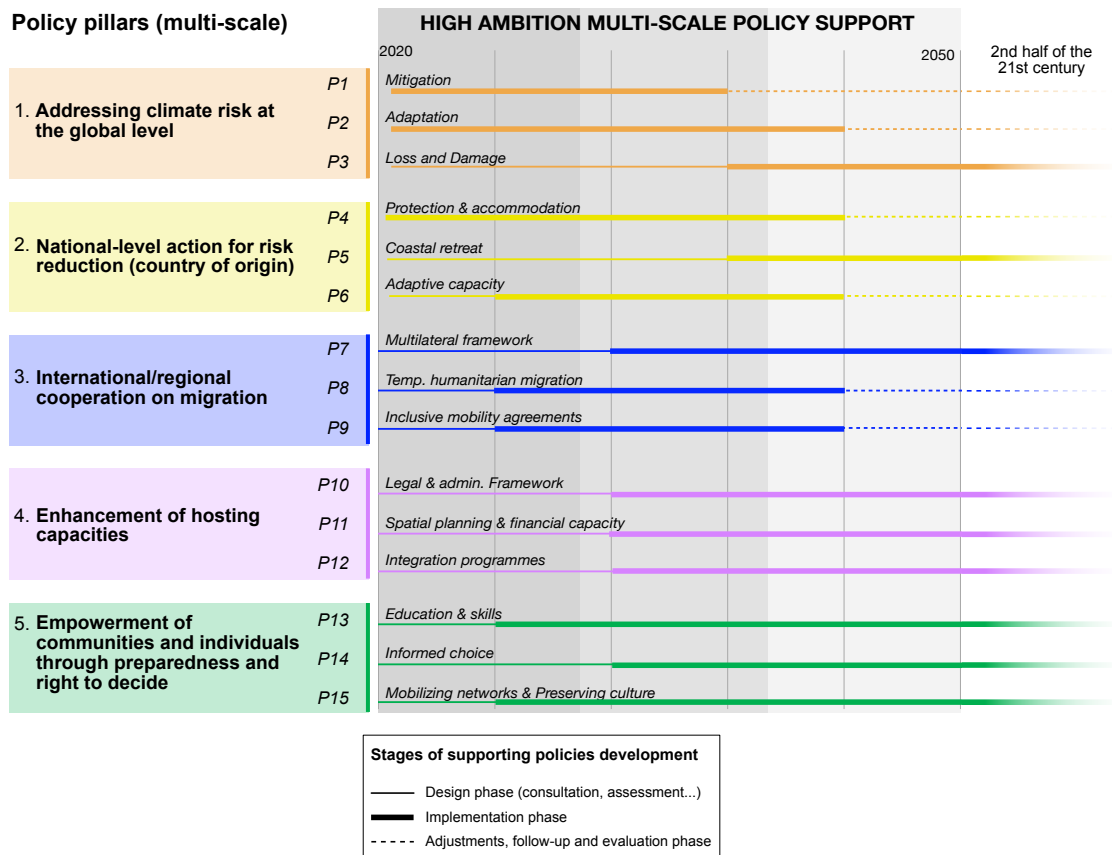
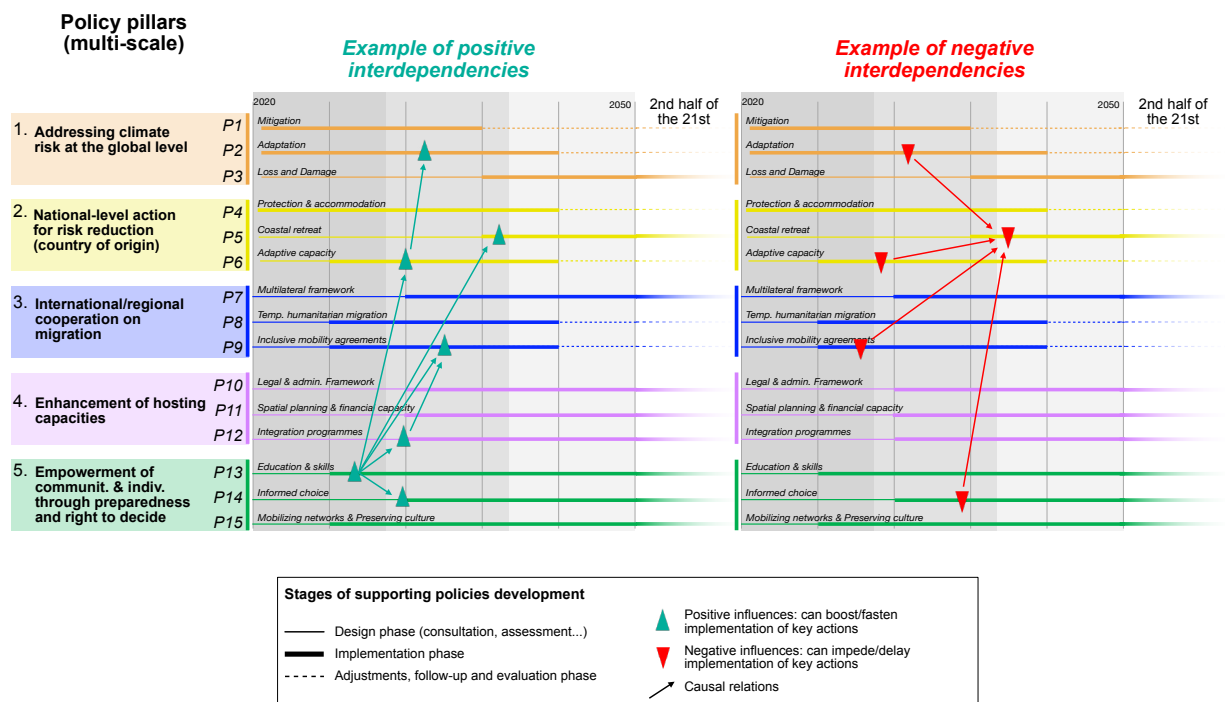


FIGURE 5. Illustrative policy pathways showing positive and negative influences (i.e. synergies and trade-offs) between policy pillars for coastal migration across borders.



(at the international, multilateral, bilateral, and regional levels) to facilitate taking into account transboundary effects of migration globally. Although based mainly on soft law (i.e. non-binding agreements), international and regional cooperation on migration can foster advancements at the national and local level thereby accelerating other processes with a lever effect. Three main policy pillars are highlighted here: *multilateral frameworks including regional agreements* (P7), *humanitarian migration mechanisms* (P8) and *inclusive mobility agreements* (P9).

In a high-ambition scenario, **(P7) multilateral framework(s)** would fully address and facilitate "safe, orderly and regular migration", including specific policies and working groups on migration related to SLC. These multilateral frameworks are starting to exist and some discussions are now taking place on relevant frameworks. At present, these processes have a limited scope by focusing on migration flows and drivers, especially on internal migration (see section 3), and transboundary risks of migration at a global scale. To advance cooperation, it would be important to address the fragmented landscape of existing multilateral frameworks dealing with migration (e.g. WIM's Task Force on Displacement, IOM, UNHCR, UNDRR, Global Compact on Migration, etc.; in relation with P3). Indeed, while some of these institutions were created before climate change became a global issue, more climate change-specific institutions that have emerged have been quite disconnected from the former. Most of these institutions include a reflection on climate change. However, there is still a need to un-silo the processes and align the activities across relevant institutions, in order to reinforce the global "operational safety net" (Brown and Dimsdale, 2021). Such cooperation will contribute to positive dynamics to preparing for and managing coastal migration, calling for a preparatory phase to design such policies and identify key actors (thin blue line in Fig. 4) and eventually reach full implementation within the next decade (thick blue line in Fig. 4). These multilateral frameworks should not be limited to the discussion on climate refugee's status (Mcadam, 2011). They should build upon scientific assessments on migration drivers and cascading implications, both positive and negative. This scenario takes into account that at least 10 years are needed to find common ground and build agreements to facilitate transboundary impacts of coastal migration, notwithstanding major geopolitical changes that can further impact the transboundary effects of migration. **Regional agreements** also have an important role to play in facilitating transboundary mobility, following some pioneering experiences in the Pacific region (Farbotko *et al.*, 2021) and in South America (Acosta and Freier, 2018).

Regarding coastal migration—and climate migration in general—a priority should go to developing humanitarian migration mechanisms and inclusive mobility agreements. Both are already discussed and have begun to be implemented.

(P8) Humanitarian migration mechanisms, i.e. designing relevant agreements and cooperation mechanisms (e.g. regional platforms) for emergency visas are crucial in the context of increasing climate-related disasters (Kälin, 2017). This should be fully operational by 2030-2040, but requires some preparation.

Once in place, such agreements would have to be reviewed and revised on a regular basis to adapt to the level of risks and vulnerability encountered by populations. One example is the Regional Conference on Migration (RCM) in Central America, the Caribbean, and North America, which adopted 'A Guide to Effective Practices for RCM Member Countries: Protection for persons moving across borders in the context of disasters' in November 2016⁶ (Acosta and Freier, 2018).

(P9) Inclusive mobility agreements will also play a role in increasing opportunities for adaptive migration. This means that there is a need to increase opportunities for non-exploitative and adaptive international labor mobility, and opportunities for non-economic international migration that prioritizes the needs of the vulnerable (elderly, youth, women, etc.) in both multilateral, regional or bilateral agreements. Drawing from existing pioneering examples (see box below), especially bilateral agreements, these mobility agreements could inspire broader cooperation on inclusive mobility agreements for example at a regional scale.

5.4 Policy Pillar n°4: Enhancement of hosting capacities (hosting country)

5.4.1 Factors of influence: Inadequate arrangements to prepare for potential migration

Changes in migration patterns should be anticipated by hosting countries in order to build resilience and avoid "migration crises" that could trigger or feed geopolitical tensions, xenophobia and social issues. Acknowledging that this topic is politically sensitive and dependent on a variety of countries' contextual factors (including institutional history), this study does not aim to be prescriptive. Instead, it aims at presenting potential policy pathways by highlighting different scales of action that could minimize risks related to transboundary coastal migration (Fig. 3).

One of the main factors that could influence the cascading risks related to coastal migration is unpreparedness, specifically certain *administrative constraints* (e.g. difficulties to deliver visas and naturalize migrants). Such constraints could entail higher rates of illegal and unsafe immigration. Similarly, *limited capacities* (material, financial, spatial) in the hosting country could also lead in some cases to the development of informal migrants' settlements in riskier areas (including in at-risk coastal zones). Difficulties to integrate migrants in the job markets, housing, education etc. because of low social acceptance and discrimination, could lead to *increased levels of vulnerability*, impoverishment and marginalization, as well as potential socio-economic tensions and conflicts (civil disorder). Hence the importance to anticipate future migration patterns with the available knowledge, and prepare adequate hosting policies.

⁶ Link: <https://www.iom.int/iscm/guide-effective-practices-rcm-member-countries-protection-persons-moving-across-borders-context>

5.4.2 Policy-supporting processes: enhancing hosting capacities

Due to uncertainties on future coastal migration patterns, it appears important to prepare and enhance hosting capacities rapidly while putting in place all of the other policy pillars. Hosting countries cannot bear full responsibility for the consequences of coastal migration, nor any other actors. At the same time, there are some key policy processes that could facilitate adaptive migration at the national scale, in order to avoid and reduce risks related to inadequate hosting capacities. Three main areas of policy action are *legal and administrative frameworks* (P10), *spatial planning* (P11) and *integration programs* (P12).

(P10) The *legal and administrative framework* refers to the structural basis of hosting conditions. This entails the development of hosting countries' capacities to prepare and implement relevant policy and legal frameworks to address coastal migration and its transboundary cascading effects, with relevant procedures to host potential incoming migrants. Putting such measures in place would facilitate opportunities of such mobility for both hosting countries and migrants. In a high-ambition scenario, it is considered that not all countries are already equipped with relevant legal and administrative frameworks to address coastal migration, therefore some capacity building is needed, given contrasting country contexts and depending on hosting capacities (thin pink line in Fig. 4). Most countries are aware of the transboundary issues related to migration in coastal areas. Therefore, to better prepare for changing migration flows, countries could start designing relevant legal and administrative frameworks by mid-decade, with full implementation in the next decades.

(P11) *Spatial planning* includes but is not limited to dedicated housing options for migrants through adapted and climate-compatible spatial planning (safe housing, sanitation, infrastructure, etc.), relevant funding mechanisms and environmental management (physical risks, management of resources, etc.). These measures could contribute to minimizing issues related to poor housing and at-risk settlements. Spatial planning requires time to become operational, as it involves a systemic reflection on urban planning and settlement more broadly within a country. In the coming decades, activities should take place to design relevant policies and funding mechanisms, given varying contexts (Esteban *et al.*, 2020).

(P12) *Integration programs* refer to socio-economic policies aiming at inserting migrant individuals and communities in the hosting country's society. In many countries, such programs already exist (think pink line in Fig. 4), or could be developed. However, a component dedicated to coastal migration would enhance the hosting country's capacities. These programs can provide opportunities to design integrated, non-discriminating policies to facilitate access to jobs, housing, education, training, health and opportunities, e.g.: including improvements such as upskilling, allowing families to accompany workers, reducing

bureaucracy, engaging diaspora populations in program development and support. Pathways to permanent residency might have to be considered, especially for cases of permanent coastal migration. This could help foster a fair and inclusive coexistence through improved migrants' integration (Farbotko, Stratford, and Lazrus, 2016).

5.5. Policy pillar n°5: empowerment and preparedness (country of origin, national and communities' scale)

5.5.1 Factors of influence: negative impacts of migration for migrants

Migration (whether temporary or permanent, transboundary or internal) can prove maladaptive for migrants because of cascading negative impacts due to resettlement, especially if not chosen. It is important that potential migrants feel empowered to make the decision on migrating (or not), which calls for participatory governance to include communities at a local-to-national scale in the decision-making process and set up preparedness measures (e.g. raising awareness and understanding; see Fig. 3). The main factors that could lead to cascading negative impacts for migrants are, first, a *lack of means* (including social networks, inclusion in economic life, cultural dimension, etc.) to enable migrants to sustain/improve their livelihoods, health and well-being in destination areas. This could potentially become a source of marginalization, and therefore is highly related to integration policies in the destination country (P11; Fig. 5). The predominance of *imposed migration*, i.e. forced migration or a top-down management of relocation led without consultations with local communities could also lead to a lack of empowerment of migrant individuals and communities in the decision to move across borders. This might have various consequences on their future (health, employment, ability to maintain existing social networks, etc.). The migrants' *well-being and identity* could also be negatively affected in cases of maladaptive migration, e.g. through the degradation of individuals' or communities' well-being and sense of identity, the loss of traditional knowledges, the erosion of socio-cultural practices and the disappearance of communities' cultural heritages and history (Serdeczny, Bauer, and Huq, 2018).

5.5.2 Policy-supporting processes: empowerment and preparedness of communities and individuals

The main set of policies to help prepare migrants for migration are identified as: Education and skills (P13), Informed choice (P14) and Network mobilization (P15). These can be implemented at a local-to-national scale in the country of origin and eventually in relationship with wider networks of cooperation.

(P13) *Education and skills* is a core feature of preparedness measures and involves education programs, capacity building for workers and raising awareness in populations. Some countries already have such policies in place, such as in the Pacific

islands (Connell, 2004; Gamlen *et al.*, 2017). These programs allow migrants to build capacities that could open opportunities in potential resettlement, and empower them to make decisions according to their situation. Gained skills could be providers of local resilience (including changing jobs) as well as opportunities to migrate. Yet, “preparedness policies” cannot be limited to capacity-building in terms of skills, and should be designed inclusively to account for all segments of the population. Inclusive capacity building aims to reduce potential discriminations because of age, gender, race, capacities, etc. These policies primarily aim at both enhancing local resilience (in relation with P6 for example) and supporting “migration with dignity” for all (Kupferberg, 2021), noting that the register of the “resilient migrant” might be analysed as “fostering individuals able to sustain good circulation and economic development” (Bettini, 2014, p.2), in an utilitarian, neoliberal vision of migration that does not account for other drivers and logics.

As shown in Fig. 4, raising awareness and building skills would also contribute to allowing communities and individuals to make an **(P14) informed choice**, regarding the options available. Along with access to information, this mainly depends upon the empowerment of communities through bottom-up participatory approaches that allow them to choose their destination (and destiny) in an informed fashion, depending upon existing policy arrangements (see P6 and P8, Fig. 5), and recognizing both their dignity and their human right to migrate. There is a need for an exploratory phase to determine the conditions for successful bottom-up approaches. As noted by Arnall, Hilson, and McKinnon (2019, p.1): “to date, most attempts to address this problem [i.e. resettlement] have taken a top-down approach in which international justice, legal and humanitarian frameworks are extended ‘downwards’ by policymakers and governments to local populations. (...)” There has been “limited systematic work” on the development of their own justice-based solutions by the peoples affected. Still, a bottom-up approach might not be the most operational approach in every context. There is therefore a need for more scientific research and local experimentation to determine tools and mechanisms that can help develop efficient bottom-up strategies.

Finally, there is a need for a set of policies to support **(P15) mobilizing networks and preserving culture**, as a part of social and cultural adaptation. This would mean implementing policies to foster transfer and preservation of migrant communities’ knowledge. This contributes notably to enhancing migrants’ well-being and preserving cultural heritages in the context of climate change. As the number of displaced populations grows, “the generations-deep connection to their rituals, customs, and ancestral ties with the land, cultural practices, and intangible cultural heritage become endangered” (Aktürk and Lerski, 2021, p. 2). This aspect is often overlooked in relocation policies. It could have global implications in terms of loss of cultural traditions and heritage, where culture plays an important role in the resilience of migrants’ communities. This field of policy and science is emerging, along with the reflection on non-economic loss and damage (McNamara and Jackson, 2019; Huggel

BOX 1: THE CASE OF PACIFIC SMALL ISLAND STATES

The Pacific Islands have been pioneers on establishing and facilitating cooperation on migration. They have been proactive to reduce the need for international migration by integrating across its policy areas the principle that adaptation can be adaptive, and is not necessarily a risky phenomenon (Kelman and Stojanov, 2020). Policy on climate mobility in the region is integrated and linked with broader development, adaptation and sustainability frameworks, mechanisms and programs. Its development has been innovative by bringing together the specificities of country contexts into a comprehensive regional cooperation framework. The Framework for Resilient Development in the Pacific integrates human mobility aspects into national policies and actions to protect individuals and communities vulnerable to climate change, including through relocation and international labor migration policies. Many island states have their own set of policies related to climate migration (including coastal migration): Fiji has a set of policies including planned relocation guidelines, displacement guidelines and Climate Relocation and Displaced Peoples Trust Fund. Vanuatu has a national policy on climate change and disaster-induced displacement, while Tonga has recently released its migration and sustainable development policy. Thus the risk of coastal impacts leading to maladaptive coastal migration is actively addressed by these policies, combined with coastal adaptation and related adaptation projects in health, fisheries, local agriculture and more (Farbotko *et al.*, 2021). There are also lessons to be learned from New Zealand’s recent offer for 100 “climate refugees visas” per year to Pacific islanders, which was abandoned six months after having been proposed. This case reveals the complexity to conclude bilateral agreements respecting both the dignity and interests of both parties (Dempster and Ober, 2020).

et al., 2019; McNamara, Westoby, and Chandra, 2021). A phase of improvement is still needed before becoming operational; yet this is a crucial issue in light of potential losses to be anticipated. Recent research suggests for instance to foster access to place-based intangible heritage rights (Aktürk and Lerski, 2021).

6. CONCLUSION AND KEY MESSAGES

Climate change-related migration across borders raises ethical and geopolitical issues globally independent of the number of people concerned. In this *Study*, we use the case of coastal migration triggered or influenced by sea-level change (i.e. rise in mean sea levels and changes in extreme events patterns) to illustrate processes at work, main influential factors of cascading effects across borders (positive and negative), and the possible combination of multi-scale policy pathways in order to enhance adaptive migration and relocation, rather than local

maladaptation (immobile populations) or maladaptive migration. The *Study* highlights, first, that coastal migration, internally or across borders, should not be considered as a risk in itself. If planned accordingly, migration can reveal positive outcomes for migrants, hosting communities, and the global society. However, there is currently little knowledge on the positive and negative cascading consequences of changing migration patterns across borders due to SLC. As a result, there is not enough strategic vision on policy and governance arrangements needed to facilitate adaptive solutions (including migration, when relevant) and avoid eventual maladaptation in both the countries of origin and destination. The *Study* highlights that managing and anticipating the cascading effects of coastal migration across borders calls for coordinated action both at the country level (country of origin

and destinations) and across countries (Fig. 4), and that synergies are to be sought between national policies and international frameworks. This way, it argues that there are strong interdependencies between policies at the national and global levels, as some decisions and policy processes at a given scale influence decision-making and action at other scales by creating positive or negative feedback loops (Fig. 5). It therefore concludes that addressing the potential cascading effects of human coastal migration across borders calls for an integrated approach of climate change impacts and migration policies over time. This is what this study formulates as "multi-scale policy pathways". These pathways are a forward-looking approach, paving the way for more dialogue and cooperation between different stakeholders in the short-to-longer term, on coastal migration.

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SUPPLEMENTARY MATERIAL

SM1. Coastal migration: expert interviews questions template

Expectations and objectives of the interviews

- Check whether the first intuitions based upon literature review are correct/valid
- Collect new insights/ideas on risks ex-post (transboundary, cascading effects)
- Test case studies/define "hotspots" to highlight
- Identify additional experts and relevant literature
- Test/go further on the bibliography

Question grid:

- 0. Preliminary : do you mind if the meeting is recorded?

As an introduction, more precisions on the projec : we do not want to study the drivers of coastal migration in itself/what triggers migration from coasts, but on transboundary risks related to coastal migration. Which means our question is not "what drives coastal migration locally", but "what are the implications across borders"?

This project takes place in a bigger initiative called Adaptation Without Borders. Our objective is to coin a new methodology allowing policymakers to have a better sense of the impacts of maladaptation. What is innovative here is that instead of focusing on national/local adaptation, we take a look at the bigger picture of cascading risks, thus showing that adaptation goes far beyond the local scale in an interconnected world.

Our four main working hypotheses are that:

- Focusing mostly on international migration, we consider that SLR-related migration is already a reality; - Even if minor in terms of the number of individuals concerned, compared to internal migration, its transboundary impacts are a dead angle of adaptation policies and current research;
- Disturbed, SLR-driven migration patterns could entail unanticipated types of transboundary risks;
- Current coastal migration scenarios might have been underrated due to conservative, linear parameters of projections or historical/current observations (and/or other factors, e.g. little scientific studies, political/diplomatic reluctances).

Considering these elements, our questions are:

Understanding deeper transboundary risks related to coastal migration

1. What are the main cascading effects/underlying risks of climate-related migration across borders (and possibly any coastal-specific aspects)?
2. What are the main factors of influence of these transboundary coastal risks (TCRs) in the future? What explains the nature and extent of the cascading consequences of migration across borders (here, coastal-related)?

Understand the drivers/mechanics of transboundary risks:

Are there specific triggering or limiting/aggravating factors?

3. To your view, would they rather be neighbouring or teleconnected (long-distance)?
4. Should some thresholds (defined by McLeman, 2018) or tipping points be considered?
5. Timing issue: will cascading effects develop/propagate rather rapidly or progressively over time? If depending on the effect considered, which ones will be rapid and which ones will develop gradually?

Understand how to manage these cascading risks

- 6.1. Top 5 things to do to limit the propagation either of cascading effects or at least their negative consequences? Why?
- 6.2. And when? Do you think some of these top 5 things are to be prioritized compared to the others?
- 6.3. What are the key enabling conditions for these top 5 actions/ things to be implemented in the near future?

Extra questions:

7. Any other advice on our approach?
8. What are for you the 10 main papers to consider ? (comprising general theory on climate migration we could have missed ?)

The transboundary implications of climate-related coastal migration: state of knowledge, factors of influence and policy pathways

Esther Loiseleur, Alexandre K. Magnan, Ariadna Anisimov (IDDRI)

The Institute for Sustainable Development and International Relations (IDDRI) is an independent think tank that facilitates the transition towards sustainable development. It was founded in 2001. To achieve this, IDDRI identifies the conditions and proposes the tools for integrating sustainable development into policies. It takes action at different levels, from international cooperation to that of national and sub-national governments and private companies, with each level informing the other. As a research institute and a dialogue platform, IDDRI creates the conditions for a shared analysis and expertise between stakeholders. It connects them in a transparent, collaborative manner, based on leading interdisciplinary research. IDDRI then makes its analyses and proposals available to all. Four issues are central to the institute's activities: climate, biodiversity and ecosystems, oceans, and sustainable development governance.

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CONTACT

alexandre.magnan@iddri.org

Institut du développement durable et des relations internationales 41, rue du Four – 75006 Paris – France

www.iddri.org
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