

Strengthening the science–policy interface in the climate migration field

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Abstract

The question of how climatic changes and hazards affect human mobility has increasingly gained prominence in public debates over the past decade. Despite improvements in the scientific understanding of the subject and advancements in policy, major gaps remain in addressing the humanitarian and socio-economic challenges related to climate migration. In this perspectives article, we argue for a holistic approach and a closer integration of science and policy involving diverse stakeholders in the process of knowledge generation and implementation. We identify five key challenges characteristic for improving the science–policy interface: (i) conflictual political contexts and the securitization of human migration, (ii) simplistic narratives and framing of the subject, (iii) the uneven production and dissemination of knowledge, (iv) limited data and analytical capacities and (v) a selective topical and methodological focus. To address these diverse challenges, there is a need for more bridging initiatives at the science–policy interface that integrate diverse disciplines, approaches and stakeholders. A closer engagement of researchers and policymakers in the form of multi-stakeholder exchanges, capacity-building activities, co-development and co-implementation processes and integrative scientific assessments can help bridge the gap to support the inclusive generation of knowledge and the development of comprehensive policies.

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INTRODUCTION

Climate change is increasingly affecting populations worldwide with significant implications for human mobility. Rising temperatures, heat and drought episodes, more severe storms and rising sea levels are expected to raise displacement risks and migration in many regions (Clement et al., 2021). At the same time, mobility constraints—further exacerbated by climatic pressures—may prevent people from leaving, potentially trapping them in places with high levels of climatic stress (Benveniste et al., 2022; Nawrotzki & DeWaard, 2018; Zickgraf, 2018). With in situ adaptation becoming increasingly difficult in many regions, this may entail existential risks for the livelihoods and health of populations (Tebboth et al., 2019; Warner et al., 2012; Xu et al., 2020). Also, migration destinations, especially cities in the Global South, are affected by adverse climate impacts. Migrant populations are particularly exposed and vulnerable, creating a novel set of challenges related to climate resilience and human security (Hoffmann & Muttarak, 2021).

Over the past three decades, the research field of climate migration has witnessed a substantial increase in the production of scientific knowledge, with a steadily rising number of studies (Beine & Jeusette, 2019; Hoffmann et al., 2020; Šedová et al., 2021; Zander et al., 2022) and two special issues published in *Science* (Wible, 2021) and *Nature Climate Change* (2019). The topic has also received more attention in national and international policy spheres with several new initiatives aimed at facilitating orderly, safe and responsible migration (UNDESA, 2015; United Nations General Assembly, 2018). The term climate migration refers to different types of movements that are directly or indirectly influenced by climatic factors, including voluntary migration, forced displacements, and planned relocations (IOM, 2007). This diversity is also reflected in the more recent climate mobility concept, which broadly considers movements of people against the background of changing climatic conditions, highlighting the variety in mobility responses (including immobility), motivations, geographies and timelines (Baldwin et al., 2019; Boas et al., 2019; Wiegel et al., 2019).

The increased public interest in the climate migration nexus has not translated into effective policy responses that comprehensively address the subject. People are increasingly at risk of negative consequences and displacement from adverse climate impacts, lacking adequate support and sufficient protection (IDMC, 2021; IPCC, 2022). Debates around the issue often follow a simplistic and deterministic narrative, neglecting the diverse nature of human movements and immobility in the context of climate change, the lived experiences of affected communities and the role of intersecting dimensions of inequality and vulnerability that shape why people do or do not move, where and when and on what time scale (Tschakert & Neef, 2022). Often, the focus is placed on migration as opposed to both voluntary and forced immobility, which have so far received less attention in research and policymaking (for noteworthy exceptions, see Adams, 2016; Farbotko, 2018; Farbotko et al., 2020; Farbotko & McMichael, 2019; Nawrotzki & DeWaard, 2018; Schewel, 2020; Stockdale & Haartsen, 2018; Zickgraf, 2018).

In this perspectives article, we argue that more transdisciplinary and transnational research as well as a stronger integration of science and policy are needed to enhance the understanding of climate migration and to address its manifold implications that consider the entire continuum between people with long-term domiciles and mobile populations (Hinrichs-Krapels et al., 2020). Migration is by its nature a dynamic and multifaceted process, which is shaped by economic, socio-political, demographic and factors at different levels (Black, Adger, et al., 2011; Black, Kniveton, & Schmidt-Verkerk, 2011; Cattaneo et al., 2019; Šedová, 2021). Typically, policy issues related to human mobility in the context of climate change are highly uncertain, value-laden and disputed, simultaneously affecting multiple temporal and spatial scales, governance levels, policy fields and socio-economic contexts (Haas, 2004; Kowarsch et al., 2016). Suitable science–policy frameworks for such complex and uncertain issues should always assess policy objectives and related means in the context of their practical implications in an iterative process and ongoing exchange with all relevant stakeholders (Edenhofer & Kowarsch, 2015). Equal representation and empowerment of underrepresented groups should lie at the core of these processes (Kowarsch et al., 2016; Nash, 2018).

Based on a review of the relevant policy landscape and scientific literature using the CliMig bibliographic database (Piguet et al., 2019), we have identified five key challenges that hinder science–policy exchanges in the climate migration field: First, the contexts in which knowledge and policies are produced are shaped by societal views on

both climate change and migration that challenge the comprehensive and unbiased engagement with the topic. Second, simplistic narratives about climate migration are still largely present in the academic and policy debates influencing how we think about and engage with the topic. Third, the production, dissemination and implementation of knowledge in the field are unevenly represented, resulting in a lack of engagement with important stakeholders. Fourth, even though there has been some improvement, data and analytical capacities are still limited, resulting in restrictions to our understanding of the climate migration nexus. And finally, the knowledge production is characterized by selective topical and methodological foci concerned with the simple assessment of relationships without gaining a deeper understanding of the underlying processes.

Building on the theory of the science–policy interface for complex and uncertain environmental issues (Edenhofer & Kowarsch, 2015), we illustrate how the science–policy interface can be enhanced to address the five challenges and to improve public decision-making and planning processes on climate migration and immobility. While a stronger integration of science and policy can lead to improvements, this should not come at the cost of scientific independence or a situation in which policy too strongly influences research (Hinrichs-Krapels et al., 2020). Independent scientific inquiry and basic research are fundamental for our understanding of human systems and their intertwined links with the environment. A too strong focus on political priorities, on the other hand, may lead researchers to overlook certain population groups, relationships and relevant research questions (Bakewell, 2008b).

Science–policy exchanges should facilitate mutual learning and open deliberation among all relevant stakeholders in a non-linear, iterative manner. These exchanges should include populations that are often underrepresented in the discourse (including communities directly affected by climate change), breaking disciplinary, methodological and sectoral silos (Piguet et al., 2018). All of this would help researchers and policymakers to better understand climate impacts on human movements in their complexity, avoiding simplistic narratives that might lead to misperceptions and ineffective policy solutions.

This paper is organized as follows. In the next section, we examine existing theoretical approaches to how science can advise policymaking. In Section [The climate migration governance and policy landscape](#), an assessment of the current climate migration policy landscape is provided. Pertinent gaps are discussed in Section [Gaps in the climate migration science–policy interface](#). Section [Challenges for strengthening the science–policy interface](#) identifies existing challenges and highlights their implications for the field. Finally, the last section presents ways forward and recommendations to achieve a closer integration of the different spheres to advance knowledge and policy on climate migration.

CONCEPTUAL FRAMEWORKS ON THE SCIENCE–POLICY INTERFACE

Different models of the science–policy interface exist, which provide guiding principles on how science can credibly and legitimately advise policymaking. These are largely normative and build on different assumptions about (i) how scientific knowledge is generated and how policymaking and the science–policy interface function, (ii) the objectives and norms for policymaking, (iii) the type of insights science can offer, (iv) the role knowledge can play in policymaking and (v) whether science should have a substantial role in policymaking at all, and if so, to what extent (Kowarsch, 2016).

Four models of the science–policy interface have been particularly influential and can often be found in practice. The first and oldest one is the *decisionist* model, which is attributed to Weber (1949, 1988). It suggests that policymaking requires normative-ethical judgements which are subjective. Therefore, political actors should have the decision-making power over policy ends. They can draw on scientific expertise if they wish but should always decide according to their own values. In the 1960s, this thinking was challenged by the second, *technocratic* model (Schelsky, 1961), which assumes that increasingly complex and wicked policy problems can only be solved with scientific expertise. Crucially, this model assumes that science can provide relevant knowledge better than any other social group and that the issues at stake do not require ethical judgements. To the extreme, this can lead

to an instrumentalization of the authority of science for policymaking, as it is described by the third, *legitimation* model (Brown, 2009), which has been criticized for misusing scientific advice. This model legitimizes policy decisions by referring to scientific insights, although—in contrast to the *technocratic* model—some actors are aware that not all policy decisions can be scientifically determined in an objective, value-free way (Edenhofer & Kowarsch, 2015; Kowarsch, 2016; Schenuit, 2017).

The first three models describe the science–policy interface as a linear process and are built on the assumption that science generates value-neutral, objective knowledge, which can then be used by policymakers. Such linear models can be suitable in simple decision contexts. However, they do not seem to be fit for uncertain, controversial and complex issues such as climate migration (Koetz, 2012; Pielke, 2007). As an alternative, more discursive models have emerged, building on complex interrelations between scientists and policymakers, which entail deliberation and exchange as well as comparative evaluation and critique across epistemic frameworks (Haas, 2004). Along these lines, the fourth *pragmatic* model by Habermas (1968) follows a non-linear, iterative approach. It is more sceptical about the role of science in policymaking on that basis that policy issues are always highly value-laden. While the model still draws on scientific expertise for determining policy ends and means, its core principle is to find a consensus between experts, policy and the public via democratic participation and an iterative discourse process. While the *pragmatic* model is advocated by many scholars, it has also been criticized for not sufficiently explaining researchers' contributions to discourses on value-laden policy objectives and means (Kowarsch, 2016).

To address this criticism, Edenhofer and Kowarsch (2015) have introduced the *Pragmatic-Enlightened Model (PEM)*, refining the existing pragmatic models. *PEM* offers a framework tailored to large-scale assessments and science–policy exchanges on environmental issues, highlighting associated complexities and uncertainties. It suggests that policy objectives and related means should always be assessed against the background of their practical implications, including related higher order effects, side effects and synergies. To derive a comprehensive picture, ongoing re-evaluations of policy objectives and measures are required. In collaboration with different stakeholders, regular assessments are envisioned that study alternative policy pathways in addition to related implications and trade-offs. While such an iterative approach requires significant effort, it could render assessments and scientific knowledge production more policy-relevant and less prescriptive, effectively supporting learning processes and the dissemination of relevant research insights.

According to the *PEM*, effective science–policy interactions should enable learning and open exchanges among all stakeholders. To this end, they should foster equal representation and empowerment of underrepresented groups, capacity building and spaces for deliberation. *PEM*-inspired science–policy exchanges have been found to have a high potential for such processes, offering an integrative framework for inclusive and extensive deliberation and transparent justification on complex policy issues (Kowarsch et al., 2016, see also Moss et al., 2021 on planned relocation).

Climate migration is a prominent example of such a vital, yet complex policy issue that affects multiple stakeholders and is influenced by a range of natural and social factors and processes (Cattaneo et al., 2019; Thalheimer et al., 2021). For example, while it is the physical impacts of sea levels rising that ultimately force people to move, these impacts depend on a range of social, economic and political factors, including climate mitigation and adaptation measures. These policies may carry unexpected implications for other aspects of human lives, such as local socio-political and economic conditions, which might likewise be related to human mobility outcomes (Horton et al., 2021; Wrathall et al., 2019).

THE CLIMATE MIGRATION GOVERNANCE AND POLICY LANDSCAPE

The governance challenges of addressing climate migration are diverse. While goals have been set to better protect climate migrants and address issues related to forced displacement, strong policy underpinning and implementation are still largely absent (Blake et al., 2021). For example, the protection gap for people displaced by climatic events as well as those who remain immobile have been repeatedly identified by scholars. Activist groups have

demanded further assistance from industrialized countries to compensate affected and displaced persons for potential transboundary damage (Doelle & Seck, 2020; Horton et al., 2021; McAdam, 2012; Robinson & Carlson, 2021; Rosenow-Williams & Gemenne, 2016; Sheller, 2018).

There is, however, a variety of examples suggesting that both international organizations and national governments are taking steps to position themselves on the issue of climate migration and to prepare for potentially higher migration pressures in areas that are strongly affected by climate change. A number of scholars have closely analysed the actor landscape of international organizations and how they are increasingly adapting to encompass questions of climate-related migration and displacement (Hall, 2016; Rosenow-Williams & Gemenne, 2016; Simonelli, 2015). For the purpose of this article, we take a broad view on governance and policies that are carried out at different levels from local and subnational to national, regional and international.

Figure 1 showcases examples of recent initiatives and developments that address climate migration with a focus on Africa. The supranational initiatives typically focus on research, knowledge-sharing, advocacy and diplomacy, but are less concerned with projects in direct contact with affected populations. The initiatives are comprised of different stakeholder groups, highlighting the broad relevance of the topic. These include research institutes, civil society organizations and think tanks, public sector and international organizations as well as the private sector.

At an international level, most recently, the International Organization for Migration (IOM) appointed a new special envoy for migration and climate action, highlighting the growing importance of this area within the IOM mandate (Rosenow-Williams & Gemenne, 2016). The IOM has built capacities over the last 15 years to assess the evidence on climate migration linkages, and to foster dialogue between science and policy (Hall, 2016; IOM, 2021). These activities are largely carried out through the institution's Migration, Environment and Climate Change (MECC) Division and supported by the Global Migration Data Analysis Centre (GMDAC). Country operations adopt the topic to varying degrees based on funding and host government interest. Operationalizing the knowledge created is still a challenge that will need further addressing.

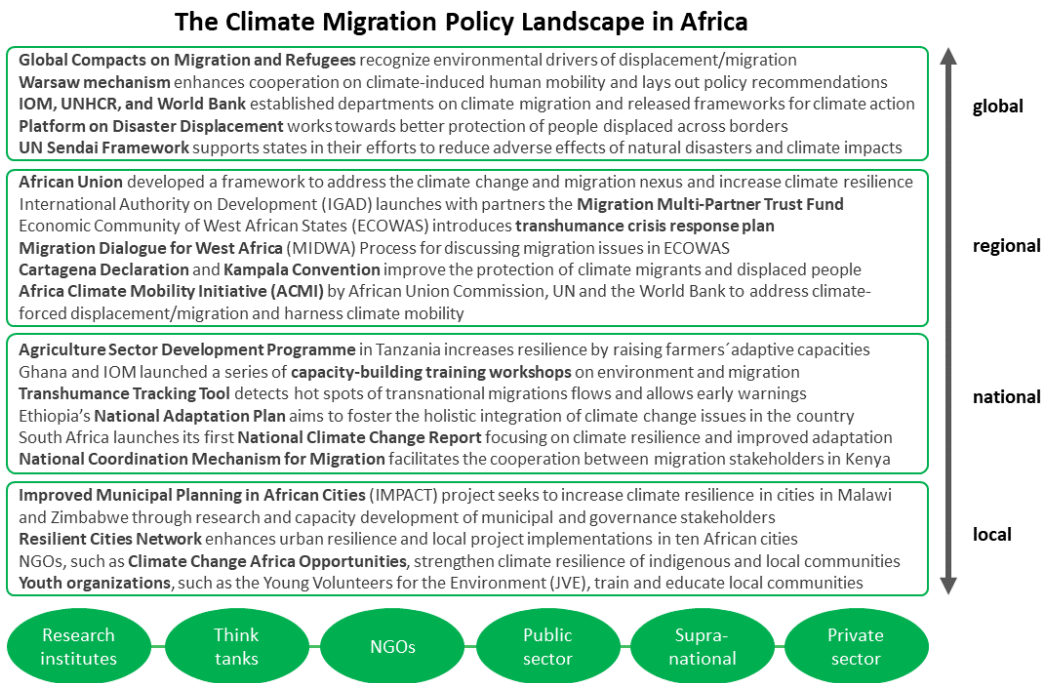


FIGURE 1 Examples of the climate migration policy landscape and its different actors for the case of Africa. The represented organizations and initiatives are illustrative of the diversity of existing policies in the region.

The United Nations Refugee Agency, UNHCR, released a strategic framework and appointed a special advisor for climate action in 2021. This marks a significant step forward for the institution to integrate aspects of climate change into their planning and operations, which have evolved over the past decade (Hall, 2016; Rosenow-Williams & Gemenne, 2016). One of the strategic framework's central objectives related to climate change is to 'guide the interpretation and application of relevant legal and policy frameworks, develop guidance and catalyze international discussions' (UNHCR, 2021). This goal could help improve the protection of people displaced by climate change, but it must be supported by national governments (Simonelli, 2015).

The Sendai Framework of the United Nations Office for Disaster Risk Reduction (UNDRR) aims to support states in their efforts to reduce the adverse effects of disasters, including those aggravated by climate impacts. The Sendai Framework and UNDRR have contributed to the prevention of forced displacement through better forecasting and disaster risk preparedness, as well as re-building resilience of communities where disaster displacement occurred (Nobre et al., 2019). In 2017, the Task Force on Disaster Displacement was established under the Warsaw Mechanism on Loss and Damage, which is part of the United Nations Framework Convention on Climate Change (UNFCCC). It lays out policy recommendations, synthesizes existing knowledge and connects subject matter experts with policy-makers (Mayer, 2017).

The Platform on Disaster Displacement (PDD), formerly the Nansen Initiative, has been bringing together governance experts, policymakers and other actors in the field of climate change and migration to explore ways to improve protection measures for those displaced across borders by climate impacts and natural disasters. It supports the national development of disaster response and human mobility policies. At the same time, the platform which is spearheaded by a group of states seeks to support the identification of possibilities to help people stay in areas affected by disasters. The PDD supports the implementation of the 'Agenda for the protection of cross-border displaced persons in the context of disasters and climate change,' which was released in 2015 and supported by more than 100 states (Platform on Disaster Displacement, 2022).

The importance of environmental factors and drivers of migration, displacement and immobility has also been addressed in international treaties (Horton et al., 2021). The Global Compact on Migration and the Global Compact on Refugees are non-binding agreements that lay out principles on how to address the respective movements of people and improve governance structures (United Nations General Assembly, 2018). The compacts also aim to increase the cooperation between countries on transboundary migration. Both agreements recognize climate as an indirect driver of movements and are therefore relevant in guiding policymaking on human mobility in the context of climate change.

Aside global initiatives, several regional initiatives and conventions exist that are relevant for the protection of climate migrants and displaced people. The Cartagena Declaration, for example, has a wider definition of refugees than the Geneva Convention, as it includes people who had to flee their countries because of 'circumstances which have seriously disturbed public order'. This could potentially pertain to extreme climate impacts which can result in widespread effects.

The Kampala Convention, a treaty between African Union member states that was adopted in 2009 to protect internally displaced persons (IDPs) explicitly references displacements occurring because of 'natural and human-made disasters' and seeks to broadly improve the situation of IDPs. The Economic Community of West African States (ECOWAS) granted populations of member states freedom of movement, but, in recent years, this has been severely disrupted by European initiatives to stop migration to the Mediterranean by preventing cross-border movements within the Sahel (Bisong, 2019). The East African Community (EAC) enables visa-free movement among its six countries and some of the countries even eliminated fees for working permits.

Planned relocations of communities and assets from areas increasingly at risk from climate change also represent a form of climate-related mobility (Horton et al., 2021; McNamara et al., 2018). Relocations have been perceived as both a form of adaptation and a form of loss and damage, for example, by the UNFCCC under its loss and damage work programme. In 2015, UNHCR together with academic partners established an international set of guidelines on climate-related relocations (UNHCR Brookings Georgetown University, 2015). At the country level, Fiji is the

first country worldwide to have established a national framework for relocation (Farbotko et al., 2020; National Legislative Bodies Fiji, 2018). While relocation policies and capacities need to be continuously advanced at all levels, an important challenge remains on how to best support those who wish to stay. Such voluntary immobility has thus far only been marginally understood and recognized in relocation planning (Farbotko et al., 2020; Piggott-McKellar et al., 2019; Zickgraf, 2019).

While the multitude of policy actors, platforms and advisory bodies suggests that significant progress was made in reducing the vulnerability of people forced to migrate or remain due to climate change, the concrete steps taken by national or regional policymakers and local implementers still lag behind. One example is the work of the Commission on the Root Causes of Displacement in Germany which laid out a number of concrete recommendations for mitigating displacement drivers including climate change (Fachkommission Fluchtursachen, 2021). However, few of these recommendations have been taken up. So far, only a few countries have started implementing policies to address climate impacts on human migration and have granted more protection to climate migrants.

Exceptions exist and these best practice examples—which are often found in regional frameworks and sub-national entities—should be scaled up. It is important to increase funds and initiatives to identify emerging environmental crises early on and intervene with adequate measures to protect the lives and livelihoods of the most vulnerable populations. Without addressing the inherent injustices that occur when people lose their homes due to climate change impacts, policies will not be sufficient in protecting people's basic rights. While efforts have been made to more strongly integrate scientists in policymaking processes—for example, as advisors—there is often no systematic process behind integrating available scientific knowledge and assessments into policy (Rosenow-Williams & Gemenne, 2016).

GAPS IN THE CLIMATE MIGRATION SCIENCE–POLICY INTERFACE

Several critical gaps in the science–policy interface limit evidence-based decision-making. First, there is no coherent institutional arrangement to comprehensively address climate migration in all its forms. Currently, no international organization has a clear institutional mandate to cover displacement, migration and relocation and to lead the response to these phenomena (Aleinikoff & Martin, 2022; Martin, 2017). Interagency cooperation remains weak, both within and across countries. Nationally, as climate migration falls between traditional division lines of ministries, such as labour, migration, health, interior and others, cooperation across different fields of practice would be necessary but is also a challenge. As a result, issues related to climate migration are often not allocated to the responsibility of a particular national ministry or sub-national entity and, thus, remain inadequately addressed.

Even if national policies on climate migration exist, they often remain broad and superficial. For example, only few Pacific Islands, which are at the forefront of bearing the brunt of climate change impacts, have dedicated policies in place to address issues related to climate migration (Thornton et al., 2021). The Nansen Agenda outlined an ambitious programme for concrete steps for action, but besides repeated calls for legal migration pathways, few concrete instruments have been discussed (The Nansen Initiative, 2015). The Platform on Disaster Displacement facilitates knowledge exchanges between a number of states and also international organizations (Aleinikoff & Martin, 2022). However, conversations between states are often halted in the description and analysis of challenges, while solution pathways are rarely developed or just theoretically discussed (Thornton et al., 2021). Their implementation would require more actors to be involved, including more people who had to move due to rising climate change impacts, city administrations that manage incoming populations (Section [Challenges for strengthening the science–policy interface](#)) and funding organizations that allow the combining of research and implementation.

A second gap is the absence of a common definition and operationalization of the term 'climate migration' or 'mobility' which curtails options to identify vulnerable populations and to tailor solutions to their needs. At the political level, the lack of a consensus on the nexus of climate-related forced displacement and migration is hindering a clear way forward that could be guided by science (IOM, 2014). Some groups dispute the existence of climate-related

migration out of climate denial or anti-immigration sentiments rooted in xenophobia and racism. The increasing criminalization of migration and stigmatization of migrants has stalled efforts to address needs of migrants and trapped populations in many countries (Atak & Simeon, 2018).

As a result, political inaction on the topic is widespread (Collyer, 2019; Zanker, 2019). Rejecting or relativizing the growing body of science around the interactions of climate and migration is politically opportune. By casting doubt on the interactions between climate change and migration, governments of high-emitting countries can disguise their responsibility for forced displacement in vulnerable countries, such as Small Island States, that can occur as a result of transboundary climate damages. Many initiatives focus on helping people adapt in situ, to avoid further outmigration (Adam et al., 2020; Bakewell, 2008a). While this is necessary to protect homes and homelands, it needs to be complemented with strategies for safe and dignified migration, in cases where climate impacts render areas uninhabitable (Xu et al., 2020).

Third, limited funding dedicated to migrants and displaced people, as well as the lack of sufficient funding for climate adaptation and loss and damages in general are hindering implementation of science-based policy advice. Furthermore, contradictions exist between financing research on climate migration while disregarding the expert knowledge policymaking and practice (Scheel & Ustek-Spilda, 2019). While in some countries advisory boards of scientists exist that have the mandate to provide evidence-based advice and guidance to policymaking, this is not a common practice around the world. Especially in countries with weak governance structures, scientists and civil society have few channels to communicate their knowledge and lived experiences to policymakers.

New avenues of funding may open up through the loss and damage fund, which was negotiated at the COP27 in Egypt (Masood et al., 2022; Wyns, 2023). Newly available funding could help implement existing evidence-based policy advice into development practice and climate foreign policy. The lack of mechanisms to implement insights generated in scientific research into concrete policies furthermore hinders development projects tailored to the needs of climate migrants. Paradoxically, while the responsibility for dissemination and stakeholder engagement is often placed on researchers, there are rarely corresponding incentives for policymakers or practitioners to engage with science. Limited capacities and resources, especially in local institutions, such as communal administrations to absorb advice and implement development solutions further aggravate deficits in migration management.

CHALLENGES FOR STRENGTHENING THE SCIENCE-POLICY INTERFACE

Conflictual political contexts and the securitization of migration

In the public debate in many countries, the topics of climate change and migration as well as related political measures are controversially discussed. Value-laden narratives and ideological positions are increasing polarization across the political spectrum in the past years in countries such as the United States or Germany. A focus on the potential negative consequences of migration for host societies and anti-immigration rhetoric in the media and policy fora have contributed to increasing out-group hostility towards immigrants (Conzo et al., 2021; Grande et al., 2019; Schaub & Morisi, 2020). These developments have challenged fact- and evidence-based arguments related to migration and have instead put forth narratives that are not connected to the realities of both immobile and mobile people, their motivations and the potential consequences of migration.

The often polarized political opinions on migration policy are highly influential for the context in which knowledge about climate migration is produced and the policies undertaken. Both scientists and policymakers working on climate and migration find themselves, on the one hand, exposed to conflictual narratives and political demands around human migration and, on the other hand, contribute to the discourses. Understanding that this context is not neutral is crucial to avoid (unintentional) misuse of expertise in the science-policy interface and potentially harmful consequences for vulnerable populations in need of protection (Cundill et al., 2021; Upadhyay et al., 2015).

Migration scholars have repeatedly warned of an increased securitization in the migration field in general and in particular in the context of climate change. The media often refer to climate change causing 'mass migration,'

'migration waves' or 'migration crises', ignoring the multi-causal, complex and layered nature of human mobility (Boas et al., 2019). Climate impacts and resulting migration patterns are presented as security threats and destabilizing force for host societies, and migrants are criminalized and profiled based on ethnicity and religious background (Elliott, 2014; Telford, 2018).

The securitization and criminalisation of migration are major aspects of contemporary migration policy. They serve as a common rationale for measures to strengthen national and regional borders and policies that aim at keeping people in their places and reduce movement. For example, where Africa is concerned, EU policies have often aimed at increasing migration controls instead of supporting affected populations (Adam et al., 2020; Bakewell, 2008a; Collyer, 2019; Zanker, 2019). This falls in line with a broader tendency to 'externalize' or 'out-source' the EU's borders, which places the responsibility on governments of origin and transit countries to prevent migrants' departures or onward journeys (Bialasiewicz, 2012; Casas-Cortés et al., 2015).

This particular context has also several implications for the science–policy interface of the climate migration field, for example, with regard to funding and research opportunities. A focus is often placed on the role of climatic factors as drivers of migration, the number of people moving and their destinations, and less on understanding the situation and motivations of affected people, including those remaining immobile. With the goal of keeping people in places, a large proportion of policies are focused on in situ adaptation, which can challenge any policy agenda that seeks to provide protection and assistance to migrants and others faced with displacement risks. Researchers, in turn, may find themselves trapped in circular calls for more and better knowledge, when several essential, policy-relevant facts are already available (Betts & Pilath, 2017; Scheel & Ustek-Spilda, 2019).

Simplistic narratives and framing of climate migration

Academic debates on the environmental change and human migration nexus date back to the 1980s (Klepp, 2017). In their earlier stages, they have been characterized by more simplistic approximations of current and future migration flows (Myers, 2002). Migrants were considered passive actors who were forced to leave their homes because of changes in the external environmental conditions (Pigué, 2013). The emphasis was on environmental and climatic factors as the main driver influencing migration in a strong and often assumed causal way.

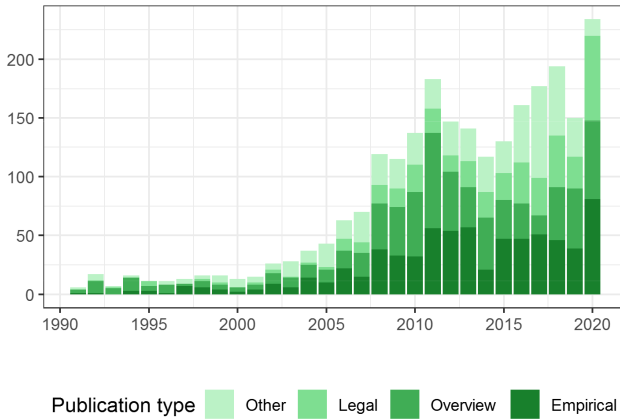
Only more recently, a stronger emphasis has been placed on understanding the role of context and local conditions in shaping migration decisions, acknowledging its multicausal nature and the diversity of migration outcomes (Black, Adger, et al., 2011; Cattaneo et al., 2019). From the late 2000s, more and more empirical and synthesis research was published as shown in Figure 2. These studies provided first-hand evidence for the multiple interactions and intertwined relationships that shape climate migration in different contexts.

Further theorization of the topic gave rise to a new narrative emphasizing that migration can serve as an effective adaptation strategy to environmental change and result in positive outcomes for migrants as well as sending and hosting communities. In this framing, both out-migrating from affected areas, as well as the use of remittances, are seen as essential risk management and survival strategies (Black, Adger, et al., 2011; Black, Stephen, et al., 2011; McLeman & Smit, 2006). Compared to the prior research, this framing highlights the role of human agency and assumes that climate migration can contribute to reducing vulnerabilities (Wiegel et al., 2019).

However, also this narrative has met criticism for neglecting the fact that for many who are forced to move, agency is extremely limited if not non-existent. By overstating the role of human agency in migration decision-making, humanitarian crises and the loss of home is ultimately normalized. Moreover, it places the responsibility to adapt on households and communities (Vinke et al., 2020). Therefore, a failure to do so becomes an individual responsibility, silencing the discussions on climate justice and unequal vulnerabilities across global, regional and local scales (Bettini et al., 2017).

Over the past decades, more nuanced perspectives have been published on migratory pressures and the power politics that shape them. The 'climate mobilities' perspective puts at its core the complexities (e.g. practices, motives

(a) Development of research field over time



(b) Distribution of publication types

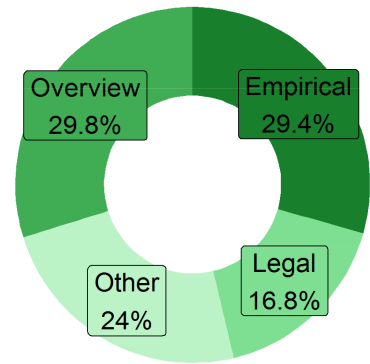


FIGURE 2 Trends and distribution of types of publications in the climate migration field based on 2594 publications. (a) Number of studies published per year by publication type (empirical, overview, legal, and other). (b) Share of studies by publication type. Overview publications refer to synthesis articles, legal publications relate to papers dealing with legal issues and/or policies and empirical studies refer to quantitative or qualitative empirical articles. *Source:* Authors' own descriptive visualization based on bibliographic data about studies in the climate migration field. Data and used categorizations were derived from the CliMig bibliographic database [accessed August 2021] (Piguet et al., 2019).

and experiences) of mobility and immobility in a changing climate. It focuses on understanding the impact of movements on places of origin, transit and destination, while avoiding any assumptions that mobility is unidirectional or monocausal, or inherently positive or negative. The goal is to better understand and capture experiences of affected populations, accounting for differential vulnerabilities, different segments of human agency and capabilities and the contextualized patterns of climate-related movements (Boas et al., 2019; Sakdapolrak et al., 2016; Wiegell et al., 2019).

Understanding climate migration and immobility in their complexity is essential for enhancing scientific knowledge and more effective policymaking (Section [Conceptual frameworks on the science–policy interface](#)). While research is increasingly adopting a broader perspective on human mobility in a changing climate, simplistic and reductionist narratives are still persistent in the public and political debates on the topic. These views often suggest a simple causal chain from climatic impacts to increased migration, while neglecting the inherent complexity and diverse nature of mobility and its varied links to the environment. Such simplification often goes hand in hand with the (sometimes underlying) notion of migration as a security threat and political attempts to reduce transnational migration and keep people in place.

Lacking diversity: The uneven production and dissemination of knowledge

As emphasized in the Pragmatic-Enlightened Model, the generation of knowledge that effectively informs policy processes, learning and deliberation among all affected actors is key (Kowarsch et al., 2016). Inclusiveness and diversity in knowledge production can lead to better collective outcomes (Haas, 2004). These go beyond the usability of scientific inputs and entail also processes of social change, determining who is involved and what type of knowledge is legitimate for policymaking (Moss et al., 2021).

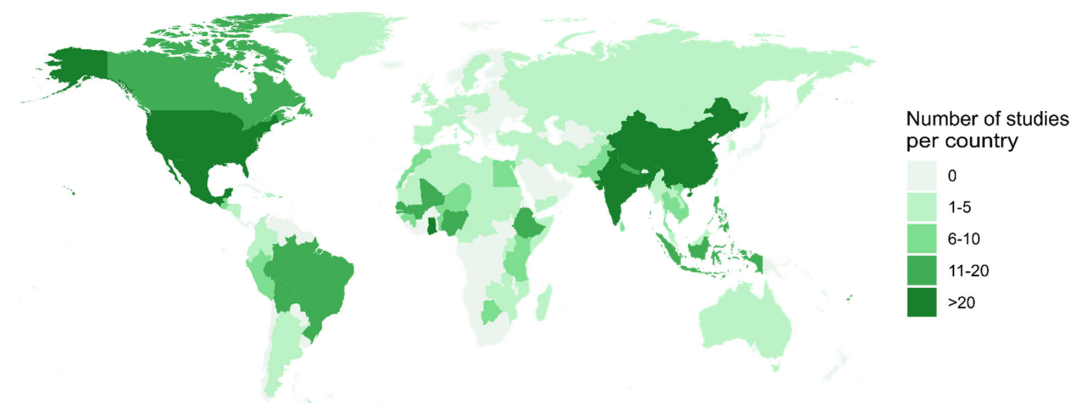
Fair, equal and inclusive deliberative processes enhance the legitimacy of decisions. Strong links between the multifaceted perspectives on an issue and a decision-making body increase their effectiveness (Kowarsch et al., 2016). On the contrary, the lack of diversity and communication among stakeholders impedes the ability of decision makers

to efficiently and comprehensively address challenges. If those affected by the use of science in formulating policy are marginalized, then this can lead to rejection and a loss of legitimacy (Haas, 2004).

The production and dissemination of scientific knowledge in the climate migration field is unevenly distributed (Hoffmann et al., 2021; Šedová et al., 2021). Piguet et al. (2018) note a strong asymmetry with researchers from industrialized countries typically carrying out research in economically developing countries. Figure 3 shows the distribution of empirical studies in the field by geographical location (Panel a) and by type of empirical methods employed (Panel b). While some countries, such as the United States, Mexico, Brazil, Burkina Faso, Ethiopia, India, and China, are covered in a range of different studies (>20), countries in other regions, such as Central and Southern Africa, parts of Latin-America as well as the Middle East are not well represented in the scientific literature. A number of reasons explain this asymmetry, including political priorities and unequal access to research funds (Giardina & Newman, 2020; Nielsen & Andersen, 2021). Limited accessibility and availability of data (see also Section [Restricted data availability and high complexity](#)) as well as limited possibilities for carrying out research in an area can also determine the selective geographical focus.

International partnerships and collaborations between relevant stakeholders in high-, middle- and low-income countries can be an effective means to integrate different science and policy perspectives. Yet, in many cases, such

(a) Geographical focus of empirical studies worldwide



(b) Different empirical methods employed

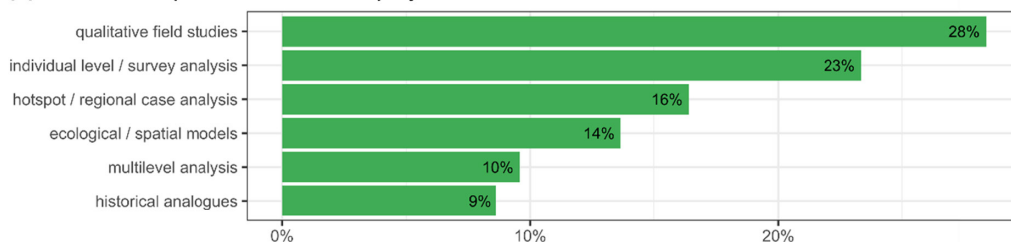


FIGURE 3 Distribution of empirical studies by geographical location (a) and study methodology (b). (a) Representation of countries in 767 empirical studies on climate migration. (b) Types of methods used in studies distinguishing between historical analogues, multilevel analyses based on area and individual characteristics, ecological models based on area characteristics (spatial analysis), vulnerability analyses and hotspots identification in regional case studies, analysis of individual data based on large sample surveys (>100) and qualitative case studies using ethnographic methods and small sample questionnaires. *Source:* Authors' own descriptive visualization based on bibliographic data about studies in the climate migration field. Data and used categorizations were derived from the CliMig bibliographic database [accessed August 2021], a comprehensive list of literature on migration, the environment and climate change (Piguet et al., 2019).

partnerships on equal footing still represent the exception rather than the rule (Piguet et al., 2018). Moreover, people who are immediately affected by climatic impacts are rarely involved neither in the processes of scientific knowledge generation nor in policymaking. This limited representation constitutes a major gap in the current science–policy discourses, which rather talk *about* than *with* the people they are concerned about (Baldwin, 2013; Nash, 2019; Schipper et al., 2021). Often in research and policymaking, the lived experience and perspectives of climate migrants and immobile people are excluded, which can limit the real-world applicability of policies and also reduce their acceptance among migrating, sending and hosting populations.

Reaching full inclusivity is a challenge, also when it comes to an equal representation of men, women and gender-diverse individuals (Leslie et al., 2015; Schipper et al., 2021). Within the IPCC, women are underrepresented (Liverman et al., 2022) and in many scientific institutions, women are still a minority among senior academics, for example, in Europe and the United States (European Commission, 2019; National Center for Education Statistics, 2018). This imbalance is also reflected in the climate migration field, where the majority of articles produced are led by male researchers (Šedová et al., 2021). Also, gender as a subject of climate mobility studies is still emerging and so far, gender dimensions are rarely mainstreamed into research designs and policy interventions, which can lead to biases (Evertsen & van der Geest, 2020; Lama et al., 2021).

This gender imbalance is also visible in policymaking. Policy processes are often dominated by men, as is the case in the UNFCCC negotiations (UNFCCC, 2019). While climate impacts on human migration have a clear gender dimension, policies on planned relocation and displacement are often inadequately gender-responsive (Ayeb-Karlsson, 2020; Becerra-Valbuena & Millock, 2021; Chindarkar, 2012; Vinke & Harper, 2020). Gender can shape vulnerability and—in conjunction with other socio-economic factors—influence migration decisions (Donato et al., 2006; Hunter & David, 2009; Myrntinen, 2017). A lack of understanding of how gender, gender identities and perceptions of masculinity, femininity and diversity shape agency and capacities in coping with climate impacts can lead to the implementation of measures that aggravate rather than solve problems (Lama et al., 2021).

Finally, a disciplinary bias is visible in the empirical climate migration literature. Among the most represented disciplines in quantitative studies, for example, is economics, followed by environmental sciences, development studies and demography (Hoffmann et al., 2021). The limited disciplinary diversity and their operation in silos can lead to gaps in the holistic understanding of climate–migration linkages and a compartmented analysis. For example, the largely overlooked interconnections between climate change, migration and health (Ridde et al., 2019) could have contributed to the mismanagement of the COVID-19 pandemic in displacement contexts, where people disproportionately lack access to basic services and sanitation (Orendain & Djalante, 2020).

Restricted data availability and high complexity

Studying the climate migration relationship comes with various challenges related to the availability of data and the modelling of climatic impacts on migration and immobility. Obtaining accurate migration data is challenging—both for researchers and public administrations—given the inherent complexity of human movements. How migration and more generally human mobility are conceptualized and measured can have important implications for research findings and hence be relevant for policy efforts (Bilsborrow et al., 2012; Fussell et al., 2014).

Especially in publicly administered data sources, such as national surveys, censuses or registry data, there is a risk that certain types of mobility affected by climatic impacts may be systematically omitted (Bilsborrow, 2016; Fussell et al., 2014). Censuses, for example, are only completed once every several years resulting in short-term and short-distance movements or displacements not being sufficiently covered. At the same time, many countries have no public migration monitoring systems in place—for example, population registries—resulting in an undercounting of migrants (Bilsborrow, 2016). Surveys can offer an alternative but come with other challenges, such as sampling biases or difficulties in the accurate measurement of migration pathways due to recall and other measurement biases (Hoffmann et al., 2021).

As highlighted in the Pragmatic-Enlightened Model, comprehensive and inclusive data and information are essential for effective policies and to ensure that mobile populations are adequately protected. Yet, significant data gaps remain, which are particularly pronounced in some world regions. In the Horn of Africa, for example, only limited migration data exist, and available data are often not publicly accessible. Data collection efforts by UNHCR's Protection and Return Monitoring Network (PRMN), IOM's Displacement Tracking Matrix (DTM) and the Internal Displacement Monitoring Center (IDMC) have contributed to filling the data gap in the region, but any collected data are often only provided in an aggregated format with limited information available at the subnational level.

In this regard, it is important to stress that the pledge for more migration data, which is often made by researchers, can come with various ethical challenges. Certain forms of migration data, such as digital trace data, can entail privacy and data protection issues (Lu et al., 2016). Data can be used as a source to systematically identify, stigmatize, and target mobile populations as part of an effort to strengthen migration and border regimes. While mobile populations are increasingly monitored by authorities, their struggles and experiences often remain invisible (Broeders, 2007; Metcalfe & Dencik, 2019). To address these issues, a carefully balanced approach between the protection of rights and the advancements of data is required. Instead of collecting more data, efforts to expand, improve and harmonize existing data sets can prove more useful, especially in areas with limited data collection capacities. Such efforts should entail a focus on subnational data, the collection of comprehensive information on migration (beyond single survey items) and the consideration of intersectional aspects while accounting for possible ethical challenges and data protection issues.

Climatic events can influence mobility in complex ways that cannot be easily grasped by researchers and policymakers. Statistical models often operate with broad categories lacking information about how a particular change has affected local livelihoods (Dinar et al., 2008; Karl & Easterling, 1999). Temporal influences and timing also play an important role in understanding climate migration but are hard to analyse, especially based on infrequently collected public data. Climatic factors often become relevant only once their impact exceeds a certain threshold beyond which a system can no longer sustain or adapt. People might first try to adapt locally before deciding to migrate from an area. This temporal and context dependency is very relevant for understanding climate migration but constitutes the inherent complexity of the issue. This challenges the translation of evidence between different contexts and the development of coherent analytical frameworks to inform policymaking (2021).

Streetlight effects: Selective topical and methodological foci

Climate migration is a complex phenomenon that is not only affected by environmental impacts but also by social, political and economic factors. The precise extent and direction of these interconnected and often non-linear relationships vary, making it difficult to understand the links between climate and mobility in different contexts and their relevance for different populations. Often, researchers tend to work on topics for which data and appropriate methodological tools are accessible and where their epistemic community has already highlighted academic relevance (Nash, 2018).

The *streetlight effect* describes such biases, leading scientific investigations to be conducted where the conditions for research are good (Hendrix, 2017). This can lead to the omission of important aspects and issues of relevance for affected communities, especially in the context of climate migration. For a long time, research and policymaking were mainly concerned with understanding *whether* climatic factors influence migration outcomes and the estimation of the number of climate migrants.

Figure 4 shows the most common terms used in the titles of studies listed in the CliMig bibliographic database. These are focused on issues of climatic and environmental change processes as well as migration. Only recently, the questions of *why* and *how* the climate shapes migration processes more broadly and how migrants and their communities (at the origin and destination) are affected by climate migration have come to the forefront of scientific considerations (Cattaneo et al., 2019; Thalheimer et al., 2021; Vinke, 2019; Zickgraf, 2021).

Supporting diverse research teams should be a priority for funders and academic institutions when it comes to the gender and geographic backgrounds of partners. Funding should further prioritize interdisciplinary and transdisciplinary research, which supports a holistic understanding and integrates different disciplines and methodologies (e.g. climate sciences, migration studies, gender studies, urban planning) to reveal unfolding dynamics in this increasingly connected and rapidly changing world (Folke et al., 2021; Ridde et al., 2019).

For scientific knowledge to be policy relevant, there is a need to enhance the science–policy interface in the long run by facilitating regular exchanges and collaborations between scientists and policymakers both horizontally (across different fields and sectors) and vertically (across different policy layers from local to national and international). Importantly, exchanges should not be one directional from science to policy and only focused on the translation and dissemination of findings at the tail end of research. Instead, more collaborative, iterative working models can be useful, such as envisioned in the Pragmatic-Enlightened Model, engaging policymakers, practitioners and the wider public early on in the research process.

More closely engaging with the users of their work in an iterative way can help researchers define policy-relevant research agendas and questions, and policymakers to integrate scientific knowledge into their work. This could be achieved, for example, through policy labs (Hinrichs-Krapels et al., 2020; Olejniczak et al., 2020), integrative working groups (Young et al., 2014) or multi-stakeholder platforms and initiatives (Aleinikoff & Martin, 2022). All of these could serve as a suitable bridge for engaging diverse partners from academia, policy, the private sector and civil society. The exchanges can also involve members of the wider public, including members from directly affected communities, enabling researchers and policymakers alike to gain insights and views from all parts of society (OECD, 2020). Similar initiatives have been successfully used in other fields both at the national and international level (Faysse, 2006; Pattberg & Widerberg, 2016). They would not only allow us to bring diverse stakeholders to the table but could also lead the way in the development of comprehensive strategies and evidence-based policies in the climate migration field.

Towards a more accurate assessment of climate migration

Simplistic narratives of climate migration not rooted in sound empirical evidence might lead to inefficient employment of resources and the implementation of policies with adverse societal outcomes (Boas et al., 2019). The IOM warns against partial simplistic solutions that do not address human migration in its full complexity (Ionesco, 2019). It therefore remains crucial to provide decision makers with accurate and appropriate information about long-term, wicked policy issues which are not shaped by normative and political viewpoints (Wiegel et al., 2019).

Integrated, multi-stakeholder scientific assessments offer a promising solution for bridging scientific expertise and public policy (Kowarsch et al., 2016; Mitchell et al., 2006). They could help extract knowledge from all relevant sectors and fields, integrating top-down and bottom-up perspectives. Such assessments aim to comprehensively represent the complexities of an issue at stake across multiple spatial and temporal scales, processes and activities. From the beginning of the process, they involve diverse experts and stakeholders, including political actors, which give them a high level of legitimacy. Prominently, they would provide a platform for comprehensively distilling and synthesizing knowledge on climate migration in an iterative manner to contribute to evidence-based policymaking that goes beyond ideological and political interests (Black, Kniveton, & Schmidt-Verkerk, 2011; Horton et al., 2021; McGuffie & Henderson-Sellers, 2005).

Integrated scientific assessments have three central characteristics. First, they assemble available scientific knowledge and identify gaps to provide an interdisciplinary and integrated picture of policy-relevant considerations. Second, they provide knowledge in a publicly accessible way to promote public policymaking processes and deliberation. Third, they consider different perspectives and weigh controversial scientific statements and approaches, uncertainty and disputed societal values and conflicting priorities. Well-known examples of large-scale, integrated scientific assessment include the assessment reports provided by the Intergovernmental Panel on Climate Change (IPCC) and the United Nations Environment Programme's (UNEP) Global Environment Outlook (GEO) series (Kowarsch et al., 2016; Kowarsch & Jabbour, 2017).

The Pragmatic-Enlightened Model provides a conceptual framework suited for such large-scale assessments of long-run environmental issues and related policy responses. It proposes a scenario-based approach which allows us to holistically assess policy outcomes by accounting for their practical implications and feedback loops (Edenhofer & Kowarsch, 2015; Kowarsch et al., 2016). Conducting such integrated scientific assessments on human mobility in the context of climate change would prove highly beneficial to synthesize the existing evidence and to derive—involving a range of stakeholders—effective recommendations for policy. While scientific assessment exists at the local (e.g. Upadhyay et al., 2021) and national level (Bergmann et al., 2021; Blocher, 2021), assessments at the regional and global level are missing. Given the steadily growing evidence base on the topic, such an integrative effort would be desirable to advance our understanding of climate-related migration and to close remaining gaps in the science-policy interface.

Improving data access by leveraging public sources

Also, in terms of data and analytical approaches, researchers, policymakers and practitioners can benefit from working hand-in-hand. On the one side, a closer collaboration can help improve accessibility and usability of existing data sources on climate impacts and migration. On the other, it can support tapping into novel sources of data that have not been fully explored. Recent efforts, such as the Global Internal Displacement Data collected by the IDMC or the Displacement Tracking Matrix and Transhumance Tracking Tools by IOM, aim at providing relevant and easy-to-use data to both research and practitioners, which can support overcoming data and information gaps at the science-policy interface.

Public organizations and policy actors play an important role in improving the evidence and knowledge base on climate migration. Often, they have access to data sources that are either not known or accessible for researchers or that are not available in an electronic format. Examples are data kept in paper format, for example, on border crossings or archive data on population registries. In some cases, data are not available through central authorities but collected by communal actors, such as information on displacements as well as conditions in displaced communities. These forms of data can have a huge potential for exploring and modelling climatic impacts on populations at a local level.

In order to leverage those sources, collaborations between scientists, policymakers and other stakeholders are once more key. Scientists have the skills and capabilities to judge and process data and to effectively link them to external sources of information, for example, related to the environmental conditions in a region. At the same time, they benefit from improved access to the data provided by their partners. Here, capacity building on the policy side is important to enable practitioners to see the hidden potential in data and to learn about how they can be effectively used to inform strategic planning and decision-making.

Important progresses have been made when it comes to data. Scientists and practitioners can now draw on a number of novel data sources that are widely available and that can be used for understanding the links between climate change and people's movements. Many Demographic and Health Surveys (DHS), Multiple Indicator Cluster Surveys (MICS) and Labour Force Surveys (LFS) now include modules on migration. IPUMS International provides a collection of harmonized census and survey data from a large number of countries, including information on migration (Bell et al., 2015; Bell & Muhidin, 2009). Gridded data on migration and population dynamics are available from the WorldPop Migration Flow database (Garcia et al., 2015), Global Human Settlement Layer (Pesaresi et al., 2013) and the Gridded Population of the World database (CIESIN, 2015). Additionally, further migration data at the national and international level are becoming available, including data by international organizations, such as UNHCR, IOM and IDMC.

Broadening the research scope and focus

In both research and policy, a shift in focus is needed with the goal of developing a comprehensive understanding that takes the entire migration cycle into account and covers different forms of mobility as well as immobility (Cundill et al., 2021). This can be achieved by (i) promoting inter- and trans-disciplinary research and multi-domain

working groups that include both scientists and stakeholders from various fields and sectors and (ii) by locally embedding the production and implementation of practically relevant and actionable knowledge in the climate migration field (Weichselgartner & Kaspersen, 2010). The production of knowledge can therefore bring different stakeholders to the table, including experts, risk bearers and local communities, to effectively achieve a co-production of scientific knowledge and a co-implementation of the knowledge in the form of policies (Vogel et al., 2007). This also involves the joint framing and development of a research and policy agenda to move forward (Young et al., 2014).

Looking beyond institutional boundaries and horizons is needed to help open up new avenues for research and policy initiatives. Addressing the climate migration nexus requires approaches that bridge the boundaries of several natural, social, legal and humanistic scientific disciplines. While inter- and trans-disciplinarity are often highlighted as important features of state-of-the-art science, they are rarely implemented in practice. For this, more incentives and better infrastructures are needed to further encourage and enable bridging research and policy initiatives. This would also shift the focus to such under-researched topics that are at the boundary of different disciplines, such as on the links between climate migration, urban planning and integration efforts; between climate migration and health; and between social inequalities and differential vulnerabilities to climate change.

In addition, from a policy side, there is a need for a systemic view and holistic approach, which consider the connections between different systems, deals with challenges in both origin and destination areas and includes the perspectives of migrants and other stakeholders. Given the multiple linkages and inter-dependencies, a just policy design needs to foster resilience and sustainability in both origin and destination contexts (Hoffmann & Muttarak, 2021). This requires policymakers and practitioners to look beyond the boundaries of their organizations, incorporate insights and perspectives from other domains and actively collaborate with others. Again, multi-stakeholder partnerships and participatory approaches, involving actors from the academic, public and private sector and civil society can serve as catalysts to develop comprehensive policies to address the complex challenges related to climate change and migration (Aleinikoff & Martin, 2022).

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PEER REVIEW

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DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available in CliMig bibliographic database at <https://climig.com/>. These data were derived from the following resources available in the public domain: CliMig bibliographic database, <https://climig.com/>.

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