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Climate crisis and human migration: the emergent sociolegal parameters of a science-based policymaking

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Introduction: The Paris Agreement, signed in 2015, is the epitome of the effort for a global consensus on the problem of climate change and its repercussions, including climate-induced migration, aimed at improving the institutional capacity for the formulation of effective adaptation and mitigation policies. One of its novel characteristics was the incorporation of science in the formal policy toolkit: States must use the best available science, as the empiricism of traditional policy-making regimes, bequeathed by an era of ordinary climatic patterns, must now take a backseat and give way to the emerging paradigm of science-based policymaking. Given the growing awareness of the climate migration problem affecting humans from all paths of life and likely to disrupt social cohesion and economic development, our era is set to become an epoch of climate migration; still, the rights of climate displaced peoples continue to be neglected.

Methods: This article examines the extent to which the Paris Agreement and associated public policies have the capacity to address climate induced migration, since international law urges States to address all critical impacts of climate change, using the best available scientific knowledge in this purpose. The analysis is based on a review of the existing literature on the science-policy interface, followed by a presentation of developing trends in international law. Subsequently, the authors attempt to present the socio-legal context of the emerging trends and assess the integration of science in climate migration policymaking. In this context, comparative case studies are presented to underscore what seems to be disparities and gaps in policy implementation in this area.

Results: Our findings show that climate change raises unforeseen challenges that have not been properly assessed by policy makers both at the international and national levels, such as the extent of climate-induced human displacement and migration and the urgent necessity for legal protection of climate-induced migrants. The lack of a concrete and legally binding framework for States is highlighted, while science is only incorporated at suboptimal levels, although there seem to be recent changes in this paradigm, suggesting a shift towards greater operational integration of scientific inputs.

Discussion: The study highlights the prospects and challenges of emerging policy contexts, especially the binding duty to use science for policymaking, resulting in specific obligations –i.e., the necessity to produce and disseminate data, and to create the necessary institutional arrangements–, given that existing policy measures remain inadequate in addressing the scale and urgency of climate induced migration. The incorporation of science in policy, although progressing, requires more robust implementation to support climate justice initiatives, that must be pursued despite the complex policy implications involved at all levels.

Conclusion: The paper suggests that efforts must be intensified in this specific direction to efficiently support initiatives toward more social and environmental justice, such as encouraging the development of climate migration databases and establishing specialized bodies. Parallel to this, it is suggested that enhancing the role of scientific evidence in policymaking should go hand in hand with strengthening the international legal frameworks; both will be essential to ensure that climate-displaced populations are adequately protected and supported.

KEYWORDS

climate-induced migration, climate change, Paris Agreement, public policy, policy analysis, multilevel governance, science-based policymaking, international environmental law

1 Introduction—prospects and challenges of the broader policy context

It is been quite a few decades since the international community realized that climate change is an urgent and potentially irreversible threat to the environment, that may impinge on human well-being and safety (UNESCO, 2007) and will only worsen in the next years. The extensive studies presented in the IPCC reports show that the phenomenon leads to extreme alterations in meteorological conditions and weather patterns with significant impacts on ecosystems and landscapes, caused by extreme natural disasters like massive floods, mega-fires, significant polar-ice retreat, strong hurricanes, and typhoons; worsening drought conditions and desertification; coastal and riverbank erosion, avalanches etc. Beyond the human and infrastructure losses, consequences include damaged fertile soil and crops, loss of sources and supply of freshwater, leading to unusable and uncultivable lands, to reduction of the viability of rural societies and economies and to increasing vulnerability of urban areas due to damages and losses of vital infrastructures. In other words, climate change and its concomitant environmental catastrophes pose serious societal threats that inevitably lead to displacement of populations from their original habitats.

In particular, seen from a societal angle, it is argued that climate change will pave the way for further conflicts over natural wealth such as land, water, mineral and energy resources (UNESCO, 2007; Intergovernmental Panel on Climate Change, 2023), creating threats to the life and well-being of populations. Still, even before such severe threats become a norm, the large-scale and human-induced degradation of ecosystems has already led to inequity and to the maldistribution of natural resources (as well as of the safe and appropriate lands), causing the devastation of communities and the massive displacements of populations. Specific studies by the International Organization for Migration (IOM) and the Internal Displacement Monitoring Centre (iDMC) have shown that tens of millions of people are displaced from their original habitats annually by climate-related or other hazards worldwide (International Organization for Migration (IOM), 2024; Huggel et al., 2015). Indeed, the iDMC in its most recent 2024 report find that during 2023 natural disasters, not all related to climate effects, triggered 26.4 million new internal displacements, across 148 countries and territories, even larger than the displacements due to conflict and war, which were 20.5 million. This trend, of a higher number of displacements due to natural disasters with respect to conflicts and war, is the norm, although the latter have a much larger displacement duration than the former. As for Greece, in 2023 we had the highest number of internal displacements in Europe, 91,000, followed by Italy with 42,000 and Spain with 24,000, most of which were due to the large forest fires. Globally Greece and Canada contributed roughly 2/3 of the global displacements due to forest fires in 2023.

Given such findings, experts and scholars raise the alarm for the growing problem (which is referred to as *climate induced migration*) and the lack of general rules of law or institutional balancing mechanisms providing a framework to address it, both in international refugee law and in international environmental law.

For the purposes of this study, climate induced migration will be defined as referring to "people who are only moving because of global *climate change*" (Mayer, 2011). The concept may be legally differentiated from the notion of *environmental migrants*, which appears to be used for migration caused by "any changes in the environment" (Mayer, 2011). While it is true that several experts use these terms interchangeably, the notion of climate migration reflects better the problem of actual human displacement due to extreme changes in weather patterns leading to large-scale natural disasters, including, as one example, the inundation and disappearance of entire small island states leaving no other choice for whole communities but to migrate and unwillingly relocate.

In legal theory, neither of the two concepts mentioned above has been clearly defined resulting in a "serious lack of consensus both on what exactly is meant by the notion of climate refugee (…) and the basis on which it should or should not be used" (Hiraide, 2023, p. 271). More precisely, a quite broad definition of *environmental refugees* was proposed by Essam El-Hinnawi, a UNEP expert, who as early as 1985, pointed out the issue of: "those people who have been forced to leave their traditional habitat, temporarily or permanently, because of a marked environmental disruption (natural and/or triggered by people) that jeopardized their existence and/or seriously affected the quality of their life" (El-Hinnawi, 1985, p. 4).

Following on from that, one may easily conceive that such an approach (along with any definition focusing on the environmental aspects, including the one proposed by the IOM in 2014; see IOM, 2014), encompasses all changes to the entire ecosystem "including and going beyond climate change" (Hiraide, 2023); namely, it may also include cases of environmental degradation which could be caused by conditions completely unrelated to the climate (e.g., industrial or chemical pollution as in the Seveso and the Bhopal accidents, nuclear contamination as in the 3-Mile island, Chernobyl and Fukushima accidents, geological catastrophes as those due to earthquakes,

tsunamis etc.). Therefore, in order to describe climate migration as one specific "form of environmental migration" (Farbotko et al., 2016, p. 536) new definitions-built around the concept of climate change-were put forward by scholars wishing to emphasize the alarming consequences of climate disasters and raise awareness on the issue. *Inter alia*, Biermann and Boas suggested referring to Climate migrants as "People who have to leave their habitats, immediately or in the near future, because of sudden or gradual alterations in their natural environment related to at least one of three impacts of climate change: sea-level rise, extreme weather events, and drought and water scarcity" (Biermann and Boas, 2010, p. 67).

At the same time, apart from the significant issue of the definition that is most suitable for tackling effectively climate-induced migration, it is noteworthy that there is no obligation for states, stemming from a binding international environmental law treaty to adopt measures that secure the rights of environmental degradation victims-caused by climate induced catastrophes-to obtain redress, as well as fair and adequate compensation; be that as it may, such lacuna leaves a certain room for maneuver. Thus, a variety of mechanisms were adopted by EU states to deal with the consequences of all natural disasters including climate ones (European Parliament, 2023, p. 13): such as, to provide *ad hoc* and *ex post* compensation in the case of a (large) natural catastrophe (in Germany and Italy); to rely on a public compensation fund (e.g., in Austria) or to lay down-like in France-a comprehensive compensation mechanism for natural catastrophes, allowing for the state to intervene as a reinsurer of last resort, namely by providing an additional layer of compensation (European Parliament, 2023). Importantly, specific measures were also adopted at the EU level, *first* to address all kinds of disasters, based on the premise that "Natural and man-made disasters can be combined or can mutually aggravate each other" (e.g., in 2013, the European Commission issued a Green Paper on the insurance of natural as well as man-made disasters; European Commission, 2013a, p. 18); taking also into account the fact that the impacts of climate change are transboundary and thus require cooperation and joint adaptation efforts (to avoid disruption of the functioning of the Single Market or increase of the economic divergence between Member States). In this context, the creation of the Solidarity Fund (EUSF) -to respond to major natural disasters and to pay the costs of emergency responses, especially as regards the reconstruction of infrastructure-and the adoption of the EU Regulation 2017/1199, were of particular importance (European Parliament, 2023, p. 14). Eventually, the adoption of a new EU Adaptation Strategy-in 2021-was a major step forward in this field as the goal was now to become climate resilient by 2050 (European Commission, 2021, p. 3). However, it seems that no specific measures or procedures were established to precisely protect climate refugees as a category *per se* (European Parliament EPRS, 2023).

In this context, a key question that is central in the research scope of this paper is how states can, or even should, address the escalating issue of climate-induced migration, especially in light of their clear obligations under international (environmental) law to mitigate all kinds of adverse impacts related to climate change, including those affecting the societal structures. In reality, the lack of specific guidelines to address this emerging aspect of climate impacts and ensure adequate protection for individuals at risk presents a substantial challenge, one that demands urgent attention and action at the state level.

Thus, in discussing the institutional issue mentioned above, i.e., the lack of legally binding rules or mechanisms providing a framework to address involuntary human displacement–, this article will *first* draw attention to the science-policy nexus in particular. It brings to the fore the well-established position that policymaking is a complex, non-linear and highly evolutionary process involving continual learning and adaptation within an environment of high indeterminacy. An integral part of this process, is the science that will be used for improving the behavioral rationality of actors partaking in the policy process. In this sense, policymaking can be seen as a form of rationality that is, of course, bounded but in a manner that contests and redefines its boundaries due to the dynamics of science. Given the urgency and societal impact of climate disasters, including climate induced migration, the evolutionary status of policymaking can be improved by making the most efficient use of scientific knowledge, data and tools (section 2). Subsequently, Section 3 will present the *existing legislative gaps* (in international migration and humanitarian law, as well as in international environmental law) but also on presenting policy guidelines and instruments which have been adopted and could be possibly used to eventually tackle the issue of climate migration, such as those of accelerating the adoption of measures based on science. Following on from that, focus will shift on the specific governance measures that could be adopted by national governments, namely, the *necessity to produce and disseminate climate migration data* and a specific individual right to freedom of scientific research that is clearly differentiated from the existing general right to expression found in many national legal systems (which should, in any case, be fully realized by implementing measures on the ground; like "an enabling environment" and the funding of "climate-change research at the level that the truly existential threat deserves," while "a diverse range of voices (should) be involved in informing climate and environmental policy"; Türk, 2023); coupled with the *creation of dedicated bodies of multidisciplinary expertise-based* on the observation that climate change and its repercussions concerns a wide-range of disciplines and thus multidisciplinary climate change bodies appear to be better suited to formulate informed, expert-based, and efficacious climate change mitigation and adaptation policies (Abraham-Dukuma et al., 2020)- with a clear mandate to consult governments in tackling climate induced migration (section 4). Based on this, Section 5 thoroughly examines *whether such legislative potential is actually utilized*, by presenting on the one hand key efforts made up to now (and the initiatives adopted) by national governments to tackle climate induced migration (in the Global North and the Global South), and, on the other hand, those scientific tools which are currently available, or are being developed by scientists, in this field. Eventually, concluding remarks are presented in Section 6.

2 Policy implications: the quest for a science-policy interface

Policy analysis, let alone policymaking, inevitably occurs within an environment of high indeterminacy. Policy problems are inherently complex and, very often, ambiguity erodes our ability to formulate precise analytical models with sufficient descriptive and explanatory validity. The operation of human agency, the activation of competing interests, incomplete information, and the non-linear pattern of cause-and-effect deployment are factors seriously impeding our ability to perform policy related tasks in a lab-like manner. It is mainly for this reason that policy analysis resists simplistic solutions and relies on

flexible approaches that, *ex ante*, incorporate ambiguity in their mode of operation. Yet, this does not imply a surrender to opportunistic relativism; it rather implies an acceptance of the fact that many norms and rules are negotiable in most societal contexts due to the plasticity of power relations and, most importantly, the evolutionary processes created by the dynamics of sociopolitical change.

The instrumental rationality of technocracy is rarely an effective cure for taming, or even capturing, policy problems. Nelson (1977) rhetorical subversion of technocentric mindsets is still valid today: if we can send people to the moon, why are we not able to solve the ghetto problem? Of course, this question constitutes no denial of the fact that people did indeed set their feet on the moon (although there are still people entertaining such a conspiratorial belief); yet it poetically depicts an enormous discrepancy in policy performance that is indicative of the intractable nature of many policy problems. Policy problems are not static entities, and they often interact with the very techno-institutional instruments applied on them in the course of implementing policy measures. Arguably, policies unravel their operation in an open-ended evolutionary manner constantly interacting both with the intended and unintended consequences of human agency. At the same time, policy actors engage with institutional structures through a process of creative policy learning, by constantly attempting to adapt their strategies and responses in line with the effects of their action. Complexity, evolution and learning are the main features of the operational environment of policy analysis.

Since Wildavsky's seminal work (Wildavsky, 1979) on the modalities of speaking truth to power, policy analysis has had no other alternative than learning how to live with complex structures and uncertain outcomes. In doing this, policy analysis is forced to operate under circumstances that constrain rationality; the constrained character of rationality stems from the fact it refers rather to the unwillingness to resign from formulating rational approaches with normative validity than to a rationality that *a priori* permeates the whole societal sphere. In a sense, this means that rationality, far from being a given, it resembles an effort and a purpose, therefore a mode of behavior constantly seeking to realize its critical potential. In the Wildavskian world of policy analysis, permanent problems rather than permanent solutions make up the dish of the day; as problems succeed one another, policy analysis, often through trial and error, strives to make sure that new solutions are better and more effective than the previous ones. It is this incremental form of rationality, coupled with the task of improving knowledge and technical expertise, that makes policy analysis such a painstaking undertaking. Under this light, policy solutions should only be treated as testable hypotheses seeking modification and improvement rather than as static, uncontested truths.

Majone's seminal contribution (Majone, 1989) echoes similar concerns, while also challenging the faith to an instrumental version of policy analysis. The main thrust of his argument is that the temptation of seeking uniformly superior policy solutions must be resisted; such an objective is mistaken and unattainable since it arbitrarily bypasses the basic fact that the policy process is strewn with conflicting interests pursuing antagonistic outcomes. Therefore, a decisionistic approach that instrumentalizes policy analysis by reducing it to an "information-for-decisions" apparatus is not a workable scenario. Foreshadowing later attempts of conceptualizing the policy process as a discourse enterprise, Majone will bring to the fore the usefulness of constructing meaningful, evidence-based arguments fostering political advocacy and persuasion. The argumentative aspect of policy analysis is of course based on the necessary tools and techniques of the craft (data, evidence, metrics and so on), but its purpose is to explore (and ideally push further) the feasibility boundaries in policymaking. This is done not by relying on an instrumental macro-rationality that allegedly exists independently of the political process, but by suggesting reasonable courses of action and by presenting persuasive scenarios for policy recommendations.

It is by no means an easy task to determine the optimal architecture for a science-policy interface. As already argued, policy is not a linear process proceeding uneventfully from the stage of initiation to the stage of formulation and thence to implementation (Hill, 1997; Parsons, 1995). Moreover, the relationship between science and policy is neither constructed nor deployed in the straightforward manner implied by positivist conceptualizations of scientific knowledge that view science simply as a neutral, value-free instrument providing impartial input to policymaking. Policymakers are highly politicized actors framing problems in ways that affect the way in which agendas and policy domains are defined in practice. Therefore, the reception of science does not happen in a vacuum. Indeed, in the eyes of the liberal tradition, the tendency of science to become autonomous of traditional institutional checks was potentially seen as a threat: "The main philosophical threat to our freedom is not that science will tempt us to invent a new materialist dialectic, or establish a "1984" style dictatorship. It is rather that if we rely on science alone we will be left with no basis for (…) determining our political goals to guide the blind forces of applied technology" (Price, 1965, p. 107).

On the other hand, it is not always productive to view science as a purely societal construction, for instance in the way that Berger and Luckmann (1972) have suggested when interpreting social reality. Whereas positivist accounts lose sight of the intricacies pertaining to the science-policy nexus, constructionist approaches often over-relativize the substantive component of science thus underplaying its societal function as a rationality maximizer (*cf.* Latour, 1987). Also, they seem to ignore the basic fact that, in the eyes of the public, epistemic communities strive to be seen as a credible and bias-free conveyor of valid and tested scientific advice. An alternative path is to draw on the work of Shackley and Wynne (1995) and their concept that science and policy engage in a process of mutually constructing the relevant policy domain. While working on global climate change modeling, Shackley and Wynne (see also Jasanoff and Wynne, 1998) attempted to chart a midway route between the positivist and the constructionist view on the science-policy interface. In their analysis, scientific research and policymaking develop jointly, thus creating a policy domain that is fashioned by both. They exert reciprocal influences both in the way that public debates energize science to conduct research, but, also, in the manner that science frames research projects in the context of political debates and government priorities.

Climate change and migration become problems of a global order. Multilevel policy design is met with its own institutional challenges, one of which is the recasting of the science-policy interface. Linear top-down policymaking, if it ever existed, cannot open the perspectives needed to address current problems. Epistemic communities (Haas, 1992), especially in the field of climate change, seem to be present and rather active in influencing policy development. Although they seem capable of converging around a set of core beliefs (Sabatier, 1998) thus adding cohesion to their epistemic problem framing, the multithematic nature and the global

repercussions of climate change as well as the tremendous pressure exerted on policymakers by the societal anxieties around climate change effects, are factors enhancing epistemic antagonisms and fragmentation. Such fragmentation needs to be addressed by putting in place inclusive and cohesive institutional initiatives aiming to foster the collaborative nature of scientific endeavors, like the CLIMPACT networking initiative in Greece.[1]

At the same time, the fusion of policy and science through mechanisms of institutional governance operating on an open coordination basis (international fora, special advisory bodies, expert foresight panels, high-level scientific commissions) is a parameter facilitating the "mutual construction" of a policy agenda with the necessary science inputs. The onus is on both science and the policy institutions: creating an open science is not independent from making the policy process more transparent and more equitable. The search for a new optimal relationship between the two domains is highly relevant for the qualitative features of the policy responses that will emerge in the current, very uncertain, stage of the human condition.

3 Lacunae within current legal frameworks and potential forms of redress

Despite the magnitude of the problem, and the acknowledgment that climate change is a cause for migratory flows, the issue is not addressed in international law. However, in theory, i.e., from a purely legal viewpoint, climate induced displacements could be regulated in two different ways (Nash, 2018):

First, (paragraph 2.1) on the basis of on international migration law-either solely or in conjunction with international human rights law-, to the extent that this framework is aimed at protecting, *mutatis mutandis*, the rights of refugees; namely, by applying already existing protective rules to this new category of migrants (i.e., to climate migrants). However, given the narrow and strictly delimited objective of international migration law, such a proposal is met with strong reservations.

Instead, (under paragraph 2.2) it is argued that the issue should be addressed by resorting to the institutional arsenal of international environmental law, given that climate migration is in essence a direct effect of the large-scale degradation of ecosystems. Unfortunately, a cursory examination of international environmental law treaties suffices to show that, again, the problem is not even referred to, let alone regulated in a detailed and binding manner. Be that as it may, experts also underline that climate-induced migration has gained prominence and traction in the context of climate change policy (Nash, 2018); in truth, one may even argue that this branch of law provided for policy instruments that could prove extremely useful for that purpose and should therefore be examined.

3.1 Limits of international migration law: a very narrow definition of refugees

Migration and displacement are ingrained in human history, as spatial movement is a key feature of humanity's repertoire of responses when forced to adapt to changing conditions (Blakemore, 2019). Nonetheless, although the phenomenon is as old as humanity, understanding the specific causes of each migratory flow, and/or defining the different categories of migrants –to eventually adopt measures and rules of law that could allow for migrants' protection– is a difficult challenge *per se*. In truth, reasons to migrate can include one cause alone or, often, several combined ones, such as war, internal community strife, poverty, and, of course, anthropogenic or natural environmental changes, thus making it difficult on many occasions to disentangle the main causes and fully understand the phenomenon in all its dimensions. As Talleraas points out, in a manner distinctly echoing the Deleuzian-Guattarian concept of nomadic deterritorialization, "the group, or migration form, migrants belong to, and thus how they are analyzed or governed, can shift over time and *en route*" (Talleraas, 2022, p. 112).

However, there is at the same time a growing necessity to enact sustainable solutions and protect displaced peoples' rights, given the increase in the intensity and complexity of migration (Sîrbu et al., 2021). In order to understand and analyze migration, individuals must, in the first place, be "labeled, governed, *and studied* as migrants" (Talleraas, 2022); second, they have to be divided into categories based on criteria that will define whether they are entitled to legal protection, since the law does *not* protect *any* category of migrants. In a nutshell, it is necessary to first differentiate between internal and international migration (i.e., to establish whether national or international law should apply), and within each of these groups, between migrants who are forced to move and those who migrate voluntarily (Talleraas, 2022). Moreover, these two sets of categorization criteria-i.e., internal-international migration; and voluntary-involuntary migration-are the only ones that are important to the law, with internal migration being regulated by domestic laws, while transboundary movements being subject to international law. Hence, it is crucial to remember that, so far, only forcibly displaced individuals are entitled to legal protection in international law, among which however, the climate induced displacements are not foreseen.

More precisely, the *Convention relating to the Status of Refugees* (UN General Assembly, 1951), adopted in 1951-read in conjunction with its *1967 Protocol Relating to the Status of Refugees*-(UN General Assembly, 1967), binds signatory parties to protect only a specific category of migrants: namely refugees, with the term being clarified in Art. 1.A. This protective regime applies to persons who are considered to be refugees on the basis of the international agreements and arrangements being explicitly mentioned (1951 Refugee Convention, Art. 1.A.1), thus delimiting the scope of protection only to the person who "owing to *well-founded fear of being persecuted* for reasons of race, religion, nationality, membership of a particular social group or political opinion, is outside the country of his nationality and is unable or, owing to such fear, is unwilling to avail himself of the

1 The National Network for Climate Change—CLIMPACT, is an emblematic interdisciplinary consortium, financed by the General Secretariat of Research and Innovation, that brings together all the major universities and research centers of Greece and Cyprus, aiming to the coordination of scientific research on climate change in Greece, creating a core of research excellence, the integration and optimization of existing climate services, early warning systems regarding natural disasters (floods, forest fires, atmospheric pollution, etc.) and the collection, calibration and distribution of climate relevant data from existing national infrastructures. It also aims to act as a multifaceted high-level advisory body for the State, policy makers and civil society on all relevant to CC issues.

protection of that country; or who, not having a nationality and being outside the country of his former habitual residence as a result of such events, is unable or, owing to such fear, is unwilling to return to it," (1951 Refugee Convention, Art. 1.A.2; emphasis added). Therefore, it is indeed vital to broaden the spectrum of causes explaining migratory flows, since the international community succeeded, at best, to provide a legal framework protecting *only persecuted* individuals (Han and Kuras, 2019).

This specific dichotomy, between forced and unforced migration, was an embedded feature in the logic of the 1951 Refugee Convention which, through its subsequent implementation, was further reinforced. However, in recent times, this dichotomy is being increasingly questioned by scholars (Thiollet et al., 2022; also Han and Kuras, 2019). In this context, it is argued, *inter alia*, that international protection should be extended to new categories of migrants, like climate induced ones; especially so, for the simple reason that natural disasters cause acute instability and insecurity, exacerbated by even scarcer resources. However, experts and scholars agree that extending the scope of the 1951 Refugee Convention to climate change migrants is not feasible, since it is difficult for climate migrants to prove that they meet the critical *sine qua non*, namely that the natural disasters they are facing could be regarded as leading to a *well-founded fear of being persecuted*; in the same way, they cannot contend that they are members of a particular social group being persecuted, as natural disasters may affect a broad array of people without differentiating between individuals or social groups (Han and Kuras, 2019; Scissa, 2022).

On this basis, although international law has already attempted to encompass new categories of migrants entitled to assistance and protection-like *internally* displaced people (IDPs) (Thiollet et al., 2022)-, *international* climate migrants remain entirely outside the scope of a legally binding obligation for protection, since they cannot be thought as facing a well-founded fear of persecution. Precisely this perspective was adopted in the 2015 case *Ioane Teitiota v. Chief Executive of the Ministry of Business, Innovation and Employment* by the Supreme Court of New Zealand after Ioane Teitiota, being actually forced to abandon his property in the disappearing island of Kiribati in the Pacific Ocean asked for protection as a refugee, following the expiration of his permit to stay in New Zealand. In this case, the New Zealand courts refused to apply the 1951 Refugee Convention, basing their rationale on the interpretation that "the act of persecution required "human agency" and that the effects of climate change were not faced by a particular social group, but rather the general population of Kiribati" (Han and Kuras, 2019). Interestingly, this approach was endorsed by the U.N. Human Rights Committee, in 2020, which stated that Teitiota did not face an "imminent threat" to his life. However, the decision also highlighted that states must consider climate change effects (e.g., the slow onset of disasters) when examining refugee and asylum claims, and that they have "a *non-refoulement* obligation prohibiting them from forcibly returning an individual to a country where climate change could arbitrarily deprive them of the "right to life" enumerated in ICCPR Article 6" (Sussman, 2023).

Hence, it appears that courts still hesitate to make the most of the rights contained in international refugee law and/or in international humanitarian law, in order to protect the human rights of climate induced migrants. It seems that the main obstacle to their granting of refugee protection status is that climate change may not be *stricto sensu* considered as a circumstance creating an imminent danger to persons, or even a direct threat to their lives (due to the absence of the human agency requirement), especially in case of slowly developing climate disasters. Therefore, the quest for an alternative way of breaking the deadlock on this matter would be to examine whether climate migration may be addressed on the basis of international environmental law, as climate migration is considered to be "one of the most dramatic consequences of global warming" (Mayer, 2011).

3.2 International environmental law framework: gaps and potential policy tools

The recognition of an interdependence between human rights and the environment was first mentioned in Principle 1 of the Stochholm Declaration adopted in 1972: "Man has the fundamental right to freedom, equality and *adequate conditions of life, in an environment of a quality* that permits a life of dignity and well-being" (emphasis added). However, given the general wording of Principle 1, no specific obligation incumbent on States could be derived from it. Still, although-as mentioned above-climate induced migrants were officially referred to by UNEP expert Essam El-Hinnawi in 1985 (European Parliament, 2023), which helped to raise the awareness of the international community on the issue, the binding instruments of international environmental law remained largely silent on the protection of climate induced migrants.

Later on, international environmental law addressed the issue of climate change in the *UN framework convention on Climate Change*, signed in 1992 and known as UNFCCC (UN General Assembly, 1992), whereby all the States committed-within a defined period of time-to "achieve (…) stabilization of greenhouse gas concentrations in the atmosphere at a level that would prevent dangerous anthropogenic interference with the climate system" (Art. 2). In order to translate this obligation to a more tangible policy mandate, United Nations Framework Convention on Climate Change (UNFCCC) (1997) imposed on States certain obligations to limit and reduce the emission levels of greenhouse gases (GHG) in accordance with agreed individual targets and to adopt policies and measures on mitigation. Despite the policy measures envisaged in these protocols, the amount of carbon dioxide in the atmosphere kept rising: in 2007, the International Panel on Climate Change made it explicit that the "warming of the climate system is unequivocal" (IPCC, 2007). Therefore, a new treaty –the *Paris Agreement*– was signed in Paris Agreement (2015), imposing on signatory parties the enhanced duty to keep until the end of the century "the increase in the global average temperature well below 2°C above pre-industrial levels" and to pursue "efforts to limit the temperature increase to 1.5°C above pre-industrial levels" (Art. 2.1.a).

In doing so, international environmental law placed emphasis on the results to be achieved (namely, to reduce carbon dioxide emissions into the atmosphere and to limit the global temperature increase to less than 2°C above pre-industrial levels) without, however, creating any kind of obligation to address the societal implications of climate change that had already started to develop in parallel. In particular, the Paris Agreement, adopted *thirty years after* Essam El-Hinnawi initially pointed out the issue, mentioned only a broad and largely wishful reference to the need that, in taking actions to address climate change, States should "promote and consider their respective obligations on human rights, the right to health, the rights of indigenous peoples, local communities, *migrants*" (Preamble); apparently, this was a wording designed to compensate what it lacked in focus and clarity with that which intergovernmental politics usually wishes to hide behind vague and obtuse statements.

As a result, although several scholars consider migration induced by climate change as being based on a combination of elements-as Mayer says, climate change is "a driver but rarely the unique cause" (Mayer, 2011)- many contend that the regulatory void on this issue, in conjunction with the absence of a mechanism for the obligatory adoption of measures to tackle it, is a serious omission in human rights protection. Therefore, seen from this angle, international environmental law is regarded to have, by omission, left room for legal uncertainty that will soon leave displaced populations severely unprotected. At the same time, the Paris Agreement provisions formulated the primary objective of tackling the effects of climate change, in a very broad manner; it mentions, in Art. 2.1. (b), the obligation of states to improve "the ability to adapt to the adverse impacts of climate change" without specifying the quality or conditions on these impacts, thus allowing the incorporation of *all* kinds of impacts, including those at societal level. It was this framework that prompted policymakers to adopt additional policies, such as the European Green Deal (precisely aimed at meeting the global climate objectives of the Paris Agreement – EU Commission, 2019) while experts expressed the opinion that the climate change crisis requires a radical and immediate coordination effort at the global level, that would leave interstate competition behind (Conversi and Posocco, 2022; Conversi, 2023), but also more specific measures aimed at precisely fostering the protection of climate induced migrants. For instance, suggestions were made to promote an extensive interpretation and application of key EU legal instruments, such as the Qualification Directive (QD), the Temporary Protection Directive (TPD) and the Return Directive (Scissa, 2022); to establish and regulate the right to a healthy and safe environment by means of an additional protocol to the European Convention on Human Rights (ECHR), otherwise to adopt a regulation on the protection of climate refugees (Karayiğit and Kiliç, 2021); or to enact a regulation by the UNGA which would recognize climate migrants' status and rights, coupled with the creation of a specific UN agency competent to promote and lead regional efforts to tackle this issue, through for example, the negotiation and adoption of specific agreements (Mayer, 2011); or, adopting specific protective rules and measures based on human rights law (Katsoni and Graf, 2021) and, above all, to agree on a precise and workable definition of climate migration (European Parliament, 2023).

Unfortunately, despite the different legal proposals presented for public deliberation, no efficient solution has yet been found. Thus, the fragmentation of national policies remains the prevailing characteristic with regard to the goal of tackling climate-induced migration. At the same time, the task of confronting such an acute humanitarian challenge begs the question of whether a different approach to the issue would be more effective and yield more results. Notably, although international environmental law treaties did not lay down any binding obligation to protect climate migration, *they still adopted a policy tool* which is not yet being used to its full potential. Indeed, provision has been made for the systematic incorporation of science and scientific data in formal policy toolkits, in the overall effort to improve institutional response capacity to climate change in the various policy fields.

It is worth noting that the utilization of scientific data and evidence was at first –though indirectly– mentioned in Art. 3.3 of the UNFCCC where it is stipulated that the "lack of full scientific certainty should not be used as a reason for postponing" measures to address climate change. This approach was clearly and expressly reinforced in the context of the Paris Agreement where it was laid down that in defining policies, all States must consider the best available science[2] (Art. 7.5 and 14.1), share information and data, and strengthen scientific knowledge on climate change problems. Following on from this, one may argue that international environmental law provided States with the necessary tool, i.e., science-based policy making, as well as the direction their efforts must follow when addressing policy goals in this field (i.e., see Art. 2.1.b making reference to: "Increasing the ability to adapt to the adverse impacts of climate change and foster climate resilience").

Be that as it may, although the Paris Agreement made a useful stride by specifying the obligation to use the best available science in order to tackle climate change, the subsequent wording of the duties resulting from such obligation remained general, if not vague. However, the argument that can be put forward here is that this obligation can, and indeed does, entail very specific rights and measures. In line with this reasoning, the next section examines what legislative initiatives could possibly result from such a duty, and to which extent these solutions would be attainable while taking into account the diverse stakes involved.

4 Measures arising from a duty to use science in order to tackle climate induced migration

Although international environmental treaties begun to promote the use of best available science to tackle climate change effects, they did so without paying due attention to the need of detailing the corresponding duties resulting from this obligation. In theory, a decision-making process designed to incorporate scientific evidence could be interpreted as imposing on decision makers a distinct obligation to *use rigorous research evidence*, instead of merely relying on empiricism and general political and ideological reasoning (see *inter alia*, van Gestela and de Poorte, 2016: "the underpinning of legislative drafts (should) rely more on independent research that is carried out according to accepted methods in the field"). Notwithstanding the perennial dichotomy between theory and practice, the issue that must be urgently addressed beforehand is that translating scientific data (alas, which ones?) into efficient, operational

2 The concept of "best available science" appears in public policy documents, as in the Paris agreement, without necessarily defining it clearly. One could attempt to define it although the term itself is quite vague and it implies that there is available science that is not "best," a notion that goes against the very essence of what we consider as science itself. Science ought to be the "best" available, otherwise it is not considered as acceptable by the scientific community itself. One can argue that the notion refers to that science that uses all relevant available high-quality data and undisputed methodological procedures in order to maximize the quality and integrity of the resulting outcome, that uses transparency and peer-reviewing and that it addresses exhaustively the uncertainties, random and systematic, of the scientific outcome. The concept has been addressed in the literature, within the realm of specific scientific themes (e.g., Ryder et al., 2010; Lowell and Kelly, 2016; Murphy and Weiland, 2016).

and well-functioning statutes, policies and practices is a problem *per se* (Biber, 2012).

In this context, the practical challenge arising is to explore those institutional arrangements that should be adopted by States so as to ensure that the best available scientific input is being incorporated in the various stages of the policymaking process and in a manner that satisfies the objectives contained in the Preamble of the 2015 Paris Agreement where, *inter alia*, the task ahead lies in: "Recognizing *the need* for an effective and progressive *response* to the urgent threat of climate change *on the basis of the best available scientific knowledge*"; (emphasis added). Having said that, this task is by no means a simple exercise and it entails inevitable complexity and fragmentation, arising from (a) the non-uniqueness of specific scientific methodologies and outcomes, demanding –at a national level– institutions and processes that lead to scientific consensus, as is the case of the IPCC at the international realm, and (b) the fact that although obligations stemming from international environmental law are addressed to States (as well as international organizations), these remain free as to the specific means for the implementation of their international obligations, through the adoption of laws debated at the national level.

On this basis, the task of taking into account science in order to address climate change, and the migratory flows caused by it, may be *first* translated into legislative measures aimed at securing the independent production of scientific data to be used, in a consistent manner, at all levels of public administration. Notably, the fulfillment of this requirement entails from one side (paragraph 3.1) the *necessity to produce and disseminate climate migration data* and the *individual right*, often connected to academic freedom, to produce and disseminate scientific information on climate induced migration; and on the other the necessity of a multidisciplinary scientific consensus regarding the main issues under discussion and the most important adaptation and mitigation measures to be adopted. *Second*, (under paragraph 3.2), these two prerequisites must be exercised within a framework of laws aimed at strengthening the production of scientific data and knowledge –along with actively promoting their use by policy-makers– at the national level. In practice, this can be done through the establishment of *dedicated bodies* securing the societal dimension of the right to formulate policy responses containing the epistemic value of using the best available science.

4.1 The necessity to produce and disseminate climate migration data

As pointed out earlier, the lack of scientific data does not constitute a reason that can be invoked by States and their governments in order to postpone measures addressing climate change (Art. 3.3 of the UNFCCC). Indeed, national governments have a distinct duty to share information and strengthen the knowledge basis on climate change problems, in line with Art. 14.1 of the Paris Agreement. In this context, countries should ensure that evidence is indeed collected, processed and disseminated by researchers and scientists from a broad range of disciplines which are relevant to the problem of climate change and its impacts (climatology, meteorology, atmospheric chemistry and physics, remote sensing, oceanography, agronomy, forestry, risk management, but also sociology, economics, political science, etc.), or any other persons working in the relevant fields. In fact, the goal to broaden and make widely available the scientific knowledge on climate change issues was clearly established in the UNFCCC in manifold ways; thus, for instance, States had to "Promote and cooperate in the full, open and prompt exchange of relevant scientific … information," Art. 4.1(h); "Promote and cooperate in education, training and public awareness …," Art, 4.1(i); and, "Promote and facilitate public access to information on climate change and its effects," Art. 6.a (ii). Moreover, these stipulations were also established and strengthened in subsequent international environmental law instruments.

Indeed, following on from the UNFCCC, the commitment to use science in the effort to address climate change was explicitly reaffirmed. For instance, in the Kyoto Protocol [e.g., Art. 9; 10.b (d)]; in the Berlin Mandate where Art. III stipulates that: "The process will be carried out in the light of the best available scientific information and assessment on climate change and its impacts, as well as relevant technical, social, and economic information"; in the Paris Agreement, via the adoption of an obligation to rely on the "best available scientific knowledge" set in the Preamble; to "share scientific information" in Art. 7.7 (a), and to "strengthen scientific knowledge" [Art. 7.7 (c)]; via the reviewing of any related scientific information by a technical expert's body, according to Art. 13, etc. Considering the above, it is clear that all States are required to adopt national measures, i.e., a legal framework– for the effective implementation of this duty. This obligation amounts to no more, and no less, than a set of domestic rules of law that would allow the carrying out of climate research warranting the production and free dissemination of scientific information as well as the development of the appropriate technological instruments for understanding and tackling climate change.

Furthermore, to avoid biases and "simplistic narratives about climate migration (that) are still largely present in the academic and policy debates" (Hoffmann et al., 2023), the persons directly involved in climate migration should be encouraged to participate and provide their viewpoint, in addition to any relevant data. Even more so because, "people who are immediately affected by climatic impacts are rarely involved neither in the processes of scientific knowledge generation nor in policymaking" (Hoffmann et al., 2023), which should by no means be interpreted as allowing for any infringements on the right to privacy of climate induced migrants (Hoffmann et al., 2023). On this basis, particular attention should also be given to the problem of accessing climate migration data, as too often this kind of data is being collected by local authorities, in an inconsistent way (IOM, 2022).

Therefore, it is critical to ensure that any scientific knowledge provided by climate researchers is duly disseminated in the public realm, for the benefit of future participation of any persons or entities interested in policymaking in this field. Legally, such thing should be secured via the protection of the right to information, so as to avoid any denial of access to climate change knowledge data (for instance, the international organization ARTICLE 19 highlights: "Research by ARTICLE 19 and other human rights and environmental organizations across the world also demonstrates that populations are still being denied access to essential information about climate change and the environment. Denial of access to information stems largely from the absence of freedom of information legislation and institutional secrecy of numerous state authorities, coupled with legislation in place in many countries which prevents access to information, including state

secret laws, national security laws and anti-terrorism legislation, all of which have been used in different parts of the world to curtail access to, and circulation of, public interest information" ARTICLE 19, 2009, p. 17). All the more so as the obligation of States to guarantee the disclosure of climate change related data was a firmly grounded right from the outset, since Art. 6.a (ii) of the UNFCCC established that the Parties shall promote and facilitate "Public access to information on climate change and its effects." Critically, the right to climate change information is additionally secured in several other instruments of international environmental law (UNEP, 2015, p. 16 et seq.) and is increasingly being promoted while placing emphasis on the full use of the potential provided by new technologies, which allow for such data to be electronically available to the public (Finck and Mueller, 2023).

However, if the objective is to engrain this rationale in the operational logic of policymaking, science and scientific evidence must be considered and utilized in an organized, systematic, and institutional manner. From this perspective, it appears that an authoritative body, reflecting the expertise of a large number of relevant scientists representing the widest possible range of related scientific disciplines, is institutionally necessary in order to strengthen the science-policy interface in the field of climate-change and its repercussions, among which the climate-induced migration.

4.2 Institutional prerequisites for the best use of climate (migration) data

The idea of an authoritative scientific body playing a central role in a science-based decision-making process is a policy element that stems from the international environmental law treaties themselves. One may argue that, from a practical viewpoint, it is not always clear *which* piece of evidence should be incorporated into policymaking as the most reliable and trustworthy (Head, 2010) or *in which particular manner* such evidence should be translated into measures binding state authority according to the rule of law (Moore et al., 2018). In other words, given the purpose to establish an appropriate and efficient collaboration framework between scientists and policy makers, the instruments and bodies needed to achieve such an objective remain to be established (Scheraga et al., 2003). However, in working out solutions, dedicated authorities, entitled to collect and assess scientific data with a mandate of translating those data into expert scientific advice informing policymaking, were created right from the outset.

First of all, the Intergovernmental Panel on Climate Change (IPCC), was created in 1988 by the UNEP and the World Meteorological Organization, to make assessments of the available scientific information on climate change (UNEP–WMO, 1988). It soon became a close collaborator of the interim secretariat of the UNFCCC, to "ensure that the Panel can respond to the need for objective scientific and technical advice" (UNFCCC, Art. 21.2). Its role was steadily strengthened, especially after the adoption of the 1995 Berlin Mandate (see Art. III, point 3).

Parallel to that, the UNFCCC also established a permanent advisory body specialized in scientific assessment –the Subsidiary Body for Scientific and Technological Advice (SBSTA)– to, *inter alia*, provide the Conference of the Parties (CoP), and any subsidiary bodies, with assessments on related scientific knowledge (UNFCCC, Art. 9.2.a); the identification of innovative and efficient technologies in this field (UNFCCC, Art. 9.2.c); or advice for scientific cooperation (UNFCCC, Art. 9.2.d) etc. The IPCC and the SBSTA were subsequently maintained to support the work of member States under both the Kyoto Protocol and the Paris Agreement (e.g., Paris Agreement Art. 13 para. 7.a and Art. 18), along with the creation of teams of experts, competent to review the consistency of the information referred to (Paris Agreement, Art. 13.11). In this context, the SBSTA placed emphasis on underlying the vital importance of scientific data for understanding and addressing climate change, while it also recognized the importance of promoting a direct engagement between the scientific community and end users of climate data and information (Sîrbu et al., 2021).

Finally, it is important to note that the Paris Agreement saw fit to espouse the idea that member States should also strengthen *their own* institutional arrangements; indeed, Art. 7.7.b provides for the strengthening of "institutional arrangements, *including* those under the Convention …" (hence, not only those under the convention; emphasis added). Therefore, national governments had to develop those governance frameworks on climate policy that would be appropriate for facilitating the objectives adopted in international environmental law treaties (while also sharing related information – Art. 7.7.a– and strengthening the scientific basis in a manner that would support decision-making, Art. 7.7.c). Still, to be fully effective, such frameworks should not limit their remit in just creating the necessary climate legislation; they should also extend their purview in creating those dedicated authorities having "a specific mandate and sufficient resources to create robust outputs and enhance visibility" (Evans and Duwe, 2021) that would enable States to successfully face climate change using the best available scientific knowledge.

In response, a growing number of States have indeed adopted and enacted climate related legislation. However, with regard to creating competent authorities, although environmental bodies were formed some decades earlier, the creation of entities dedicated to the issue of climate change in particular is a more recent practice (Evans and Duwe, 2021). Consequently, there is a scarcity of national bodies serving the purpose to specifically gather and enhance the scientific output and data in a methodologically complete and democratic manner, let alone to "inject science into the policy-making process and enhance government accountability" (Evans and Duwe, 2021) in the field of climate change and climate induced migration. Thus, the general picture is that only a few legal systems contain any tailored measures (including specialized bodies) that specifically address human mobility in the context of climate change (International Organization for Migration (IOM), 2018).

Generally, it appears that current policy inefficiencies are mainly related to the fact that the overall policy toolkit is not yet fully developed, especially with regard to the main hurdle of finding optimal solutions to the problem of coupling the best available science with the policy-making cycle. New approaches proposed by experts in this field (such as Theokritoff and D'haen, 2022) argue, on the one hand, for the need of securing that adequate scientific evidence is produced "at the right temporal and spatial scales," and, on the other, for augmenting the value of scientific inputs on climate induced migration by creating dedicated bodies at the national level that will maximize the use of these scientific policy inputs.

In the light of the above, it is important to search for those measures that would maximize the utilization of scientific data in the

context of formal policymaking in the field of climate migration. This is not to underplay those steps which have been taken until now. Indeed, there have been a few practical initiatives trying to bridge the gap caused by the absence of a clear international legal framework binding States to the protection of climate-induced migrants. However, it is important to examine whether they have succeeded in integrating the best available science in their *modus operandi* and, also, to discuss what needs to be done on the basis of recent developments in the field of climate-induced migration.

5 Climate migration policies—charting routes for further improvement

Given the powers vested on states by virtue of their sovereignty, one may be excused to suppose that integrating climate science into policymaking is a straightforward exercise. However, notwithstanding the fact that scientific input has gradually started to make its way into climate policy, it appears that policy measures addressing migration induced by climate change have only managed to utilize science at suboptimal levels. From an outcome perspective, it would seem that there are still barriers preventing policymakers from using the entire potential of knowledge in the fields of environmental science and research.

Therefore, this section will present and examine a few key policy initiatives adopted thus far –mainly at the regional and at the international level– showing the extent to which climate science is (or is not) integrated especially with regard to addressing the issue of climate-induced migration (paragraph 4.1); then, paragraph 4.2 will gather and assess examples from the bibliography on the scientific tools that could be used in the future for improving the capacity of policymaking to achieve the goals established under international environmental law for alleviating the negative consequences of climate change including, of course, climate-induced migration.

5.1 Policy initiatives on climate migration and the contribution of science

As it has already been stressed, no legally binding international framework has yet been put in place in order to address the growing problem of climate-induced migration. However, in the face of increasing public pressure to tackle this issue, several initiatives were adopted at the international, regional and national levels. The three levels—international, supranational (EU), and national—are interconnected, given that states are bound by international environmental law treaties laying down obligations (e.g., both the UNFCCC and the Paris Agreement have an exceptionally high rate of ratification), which they must implement via national laws. Indeed, although international law creates binding commitments and raises awareness, its general wording requires further clarification at the regional level (e.g., the EU imposing additional measures) and effective implementation at the national level. As a result, although states commit to international treaties, the key step still lies in adopting clear and effective regional (and national) implementing frameworks and laws with a specific content, coupled with the necessary mechanisms and funding, as well as consequences to ensure their actual implementation. All levels are equally important, as signing international treaties is insufficient without corresponding regional and national legislative and operational actions to apply and fulfill the obligations contained therein. Yet, as a general rule, one may argue that there is a noticeable difference between measures and policies adopted by countries and regional organizations of the Global North (4.1.1), and entities in the Global South (4.2.2) where, presumably, the effects of climate change are more pronounced and acute (*nb*., national legislative initiatives in the Global South seem to lend credibility to this argument). Some examples are presented below.

5.1.1 Climate migration data in measures and policies adopted in the global north

Being a key player in the regional architecture of the Global North, the EU acknowledged the issue of climate migration in the late 90s. In the context of that time, it made clear reference to the growing number of "environmental refugees" fleeing from climate disasters (*inter alia*, European Parliament, 1999) while also, in the vein of a securitization agenda, it highlighted the fact that this new kind of migration could as well pose threats to EU security (European Council and European Commission, 2008; European Commission, CORDIS, 2009). Following on from that, the perspective which seemed to prevail is that there is a wide range of migration patterns; hence, policy responses must be tailored to precisely adapt the particular needs and conditions of each specific climate disaster in each country, and aim to involve all the actors concerned through an adapted *in situ* approach (European Commission, 2013b; European Commission, 2016).

On this basis, the EU considered the problem posed by climate-induced migration when reshaping its external policy framework and it tried to strengthen its resilience at all levels. The EU focused mainly on addressing protracted crises such as environmental degradation, climate change, migration, and other categories of forced displacement (European Commission, 2017). The adoption of the *European Green Deal* in 2019 (European Commission, 2019) was a promising move since climate change was presented as being a "threat multiplier and a source of instability" which must be faced, to "prevent these challenges from becoming sources of conflict … and forced migration." Sadly, the *European Climate Law-released* in 2021-did not address climate-induced migration, apart from a very general reference to the fact that the climate action program of the EU and its Member States "aims to protect people" (European Union, 2021). Therefore, the EU framework did not eventually manage to make the decisive step forward and address the issue of climate-induced migration by establishing a comprehensive legal and institutional framework. Instead, it opted for a case-by-case approach based on empirical evidence collected on the basis of an *in situ* approach, rather than on best available science that would examine and study climate-induced phenomena from a global perspective.

In this context, one may note that very few EU states adopted measures to ensure the protection of climate-induced migrants, and only sporadically; as in the case of Italy, where Art. 20 bis of the *Legislative Decree 286/1998* titled "Consolidated Act on Provisions Concerning the Immigration Regulations and Foreign National Conditions Norms" provides that the competent authority "may adopt temporary protection measures to fulfill relevant humanitarian needs in the case of (…) natural disasters or other serious events in non-EU countries" (Scissa, 2022; also European Commission, 2023). Simultaneously, other countries in the Global North –such as the US and Australia– seem to have adopted measures along similar lines,

although these remain of a very focused yet sporadic content (practically, they could also indicate the emergence of a potential paradigm shift; hence, these measures are presented in the concluding section). Therefore, in general, adoption of this kind of measures remains at the discretion of the member States.

Still, as a rule, the interrelation between climate change and migration caught the attention of the Global North over a decade ago, which however resulted in initiatives that still require time to prove their effectiveness. In particular, specific milestones were adopted during the CoP 16 meeting, in Cancun, where the Cancun Agreements were agreed upon (see, Conference of the Parties, 2010), laying down that "all Parties (must) enhance action on adaptation under the Cancun Adaptation (…) by undertaking, *inter alia* (…) Measures to enhance understanding, coordination and cooperation with regard to climate change induced displacement, migration" (Art. 14.f). However, this provision did not clarify the measures that should be adopted to address climate change-induced migration, thus creating confusion among states as to its implementation. At the same time, the Nansen Conference which took place in June 2011 did not contain any direct reference to cross-border movements arising from climate disasters, or to measures that should be adopted in this context; thus as a response, Norway and Switzerland launched in 2012 the Nansen Initiative, "as a state-owned consultative process, outside the UN, to build consensus – in a bottom-up way – among interested states about how best to address cross-border displacement in the context of sudden-and slow-onset disasters" which resulted in the adoption of substantial actions over its three-year tenure (Kälin, 2012; also McAdam, 2016), such as the Platform on Disaster Displacement.

In essence, no overall policy framework has emerged as yet in the Global North, and the picture remains rather patchy. Admittedly, the CoP seems to be willing to move in a more decisive manner, as Paragraph 14(f) of the Cancun Adaptation Framework called for more knowledge on the climate-migration nexus (Nash, 2018). However, several developed countries and their organizations exhausted their approach in committing themselves to provide economic and social support through an *in situ* approach; e.g., in the form of investments, assistance and transfers of technology and expertise, *inter alia* in the areas of Sahel, the MENA region and the Asia Pacific (European Parliament EPRS, 2022).

5.1.2 Science in the policy frameworks of the global south

In contrast, examples of domestic as well as intergovernmental collaboration from the Global South show that several policy frameworks have been established with the objective of *precisely* tackling the issue of climate-induced migration in a concerted manner. On the one hand, at the country level, there are States which have adopted specific policy frameworks: e.g., Bangladesh which released a National Strategy on the Management of Disaster and Climate Induced Internal Displacement (2015); Kiribati establishing a relocation strategy (the Migration with Dignity policy); Vanuatu, which enacted a National Policy on Climate Change and Disaster-Induced Displacement (2018) are relevant cases for consideration. On the other hand, at the regional level, a development with crucial significance was the adoption of intergovernmental frameworks to precisely address climate-induced migration, such as the *Kampala Convention* by African Union (2009) and the *Lineamientos Regionales* in Latin America in 2019.

Africa has a rich and long-standing tradition of protecting refugees, environmental or not; the *OAU Convention Governing the Specific Aspect of Refugee Problem in Africa* (1969) was the first regional binding instrument aiming to protect refugees, and intended to complement the 1951 *Refugee Convention* (Abebe, 2011). Furthemore, the more recent Kampala Convention –*AU Convention on the Protection of and Assistance to Internally Displaced Persons*– establishes an obligation to protect and assist Internally Displaced Persons (IDPs), including the ones displaced by natural or man-made disasters (Kampala Convention, Art. 9). In this context, national governments must strengthen all regional and national measures needed to prevent, mitigate, and eliminate the root causes of internal displacements (Art. 2.a) and adopt a framework for protecting and assisting IDPs (Art. 2.b). More precisely, they are under the obligation to adopt laws and create the necessary authorities to reach this goal (Art. 3.2), ensure protection to IDPs without discrimination of any kind (Art. 5.1), and cooperate upon the request of any country concerned (Art. 5.2). However, with regard to the use of best available science, they are only under the general obligation to devise adequate early warning systems (Art. 4.2) and to share information and data on the "situation of displacement" (Art. 8.3.e).

Soon after the adoption of this comprehensive framework in Africa, the *Regional guidelines on the protection and assistance of cross-border displaced persons and migrants in countries affected by disasters* were adopted in 2019, by the South American Conference on Migration (South American Conference on Migration (SACM), 2019). The guidelines were negotiated and agreed upon in the context of the *Cancun Adaptation Framework* (see Conference of the Parties, 2010, Art. 14–), which is urging States to create and strengthen regional responses and networks to address climate change issues. The guidelines are non-binding; however, among other things, they did establish a framework of minimum protection standards and created a mechanism allowing countries to request and receive guidance for decision-making at the governmental level. Signatory States remain free to apply the guidelines, but they are encouraged to develop and strengthen long-term solutions for climate-induced cases of human displacement, without however being prevented from adopting national policy frameworks that would be more protective than those laid down in the guidelines.

Undoubtedly, both frameworks emerging from Africa and Latin America indicate the gradual formulation of a novel intergovernmental paradigm in the field of climate-induced migration, especially in connection with confronting population displacement *per se*. However, a careful examination of the respective texts shows that those elements related to the contribution of science are a not, as yet, developed. In particular, signatory parties have not committed themselves to create and develop, either in common or independently from each other, an institutional interface between science and policymaking in the field of climate-induced migration. In addition to that, research shows that there are significant practical obstacles to the production and utilization of scientific knowledge, and by extension to its application in policymaking, in many countries of the Global South.

Indicatively, with regard to African countries, experts note the lack of financial resources, insufficient human capital and technical capacity, the lack of time series of observational data sets, the insufficient number of public administration personnel with the required technical expertise, and finally the absence of collaboration protocols, at the national level, between different research agencies,

universities and ministries (Theokritoff and D'haen, 2022). Correspondingly, similar issues seem to impede Latin American countries and the Global South in general, especially with regard to the lack of primary scientific data (especially over long periods of time) which are a key requirement for making assessments that could be used for policy foresight (Huggel et al., 2015). Finally, it is also noted—and relevant globally, South and North - that the different time frames of perception within which different actors operate, especially policymakers and the administration, on the one hand, and scientists, on the other, is a factor aggravating coordination and collaboration problems in developing an efficient science-policy interface (Huggel et al., 2015).

In response to the above, scientists and experts in the field of climate-induced migration have intensified their efforts to confront and understand the various aspects of the phenomenon. The quest for constructing and developing the appropriate scientific tools and methodologies which could be used for the purpose of policymaking represents a significant part of this endeavor. Consequently, several promising theories and instruments have been suggested for further development with a view to integrate them in policymaking in an organic manner.

5.2 Climate migration: the quest for an interface between science and policymaking

Considerable progress has been made in the understanding of the problem of climate-induced migration, and in developing new and more appropriate scientific tools. By way of illustration, experts have elaborated models locating the most significant interactions and dynamics which lead to climate migration by means of a "systems-based approach for the synthesis of interactions and feedback loops." The idea behind this proposal was that the patterns discerned, and the scientific information provided, could be used to better anticipate the consequences of climate change and translate them more readily to concrete policy recommendations in the context of a climate adaptation strategy (Nabong et al., 2023).

More precisely, some of the tools suggested included the use of spatial vulnerability modeling or hazard analysis modeling with hazard being defined as "a generic term denoting any potential life course event, such as changing jobs" (McLeman, 2013). In developing these tools researchers focused on gathering and processing a wide range of data, for instance data from "geographic information system (GIS) and remote sensing technology (RS) … population data, and agricultural economic data to calculate which places and populations will suffer from the negative impact of climate change" (Liang et al., 2023) etc.

Importantly, the prevailing challenge for researchers working on climate-induced migration is the scarcity of relevant data; many data are either unknown, or unaccessible to researchers, especially those data that are collected by local authorities, whereas in many cases the data that exist are rarely available in electronic format (see Hoffmann et al., 2023). At the same time, this problem is strongly exacerbated by the "different national conditions and regions, the existing theories, models, and practical experience of climate migration" (Liang et al., 2023), in conjunction with the inexistence of facilitating scientific collaboration platforms and the low level of cooperation between scientists and research institutions, in the Global North and the Global South. Furthermore, it has been noted that more researchers from the Global South should be included in research and policymaking initiatives, as their countries are more exposed to climate change and thus have a direct and diverse experience of relevant disastrous events as well as of climate-induced migration (Hoffmann et al., 2023). In addition, governments and intergovernmental institutions should promote more actively interdisciplinary research and collaboration in order to deepen their understanding of the nexus between climate change and migration which evidently requires input from different scientific fields such as meteorology, geography, chemistry, demography, economics, sociology, agronomy, etc. (Liang et al., 2023). One should also acknowledge the inherent difficulty of policymakers in incorporating scientific evidence in policy formulation due to the inherent pluralism of scientific opinions and occasionally conflicting scientific outputs. The necessity of reaching a scientific consensus that incorporates the best available scientific knowledge, evidence and data stems from the fact of the non-uniqueness of specific scientific methodologies and outcomes, demanding the institutional formulation of collaborating platforms that gather the combined relevant scientific community, research and academic institutions and a procedural layout with specific processes—agreed upon by administrators and scientists—that will lead to a multidisciplinary scientific consensus regarding the issues of climate-change and its effects. This would then provide a clear and operable scientific framework that will facilitate policy-makers in incorporating scientific evidence, knowledge and data in policy formulation.

Arguably, current inefficiencies can be partly attributed to the fact that climate-induced migration is a nascent field of research that has not, as yet, developed its full potential. As it has been pointed out, "models that can capture the breadth of possible migration outcomes while incorporating reliable assumptions about adaptive behavior represent the next stage in climate-migration modeling, one that scholars are just entering" (McLeman, 2013). Undoubtedly, the findings generated by such forthcoming models pose the question of their incorporation in the proper institutional environment. It appears that creating a dedicated authority remains an essential factor for the proper utilization of this kind of scientific information and the generation of tools fit for good governance and optimal policymaking.

Of course, in order to be effective, any (advisory or planning) authority, or body, in this field of policymaking should meet a minimum set of requirements such as a clearly delineated form of governmental involvement, a dedication to the pursuit of climate change policy and a particular composition (Evans and Duwe, 2021), aimed at guaranteeing its reliability. Thus, the legal provisions ought to ensure that the authority is systematically solicited by national administrations to provide information and expertise on climate-induced migration issues in a structured manner that is timely, stable, and financially viable. Last but not least, to the extent that the true and long-term impact of these bodies depends on their mandate, they should be legally entitled to provide policy input on climate-induced migration in the context of an institutional design that goes beyond that of publishing mere policy recommendations; namely, to create an institutional design that secures, in practice, the organic embodiment of scientific findings in the various stages of the policy cycle.

While it is true that several national authorities have been established with a mission to assist national governments in addressing more effectively the consequences of climate change, the overall

picture is that there is still a limited "ability to draw inferences on the *exact* role each body plays in its country's climate policymaking" (Evans and Duwe, 2021; emphasis added). Despite this, the prevailing view is that these dedicated authorities are necessary to provide decision-makers with "depoliticized and credible information and advice on targets, policies and progress in meeting them," while they additionally have a major role in increasing engagement with challenging or novel policy issues (see, Averchenkova et al., 2024). In other words, to be efficient, dedicated bodies should have a clear mandate as well as sufficient funding, coupled with "the strength of the statutory requirements on the government to consider and respond to their advice" (Averchenkova et al., 2024).

For these authorities to have chances of success, some kind of institutional incentives should be adopted in the near future with the purpose of encouraging policy makers to effectively use science in their efforts to tackle climate change; for, as experts argue, no real incentives –for policymakers and governments– have been enacted up until now (Hoffmann et al., 2023). Indeed, interviewees from ministerial technical units and/or civil society organizations (in countries of the Global South) noted that "policy-makers neglect data collection and production and do not consider scientific information as fundamental for the formulation of policies" (Theokritoff and D'haen, 2022). Moreover, it is argued that the task of strengthening climate institutions, in ways that counterbalance the tendency that is inherent in states to circumvent compliance and accountability, is a task generating additional political value since a "lack of clear consequences for non-compliance (i.e., with climate framework laws) poses serious credibility challenges and risks to democratic norms" (Averchenkova et al., 2024).

6 Conclusion

The above analysis showed that climate change raises new challenges of a critical nature that have not up to now been properly addressed, such as the protection of the human and fundamental rights of climate induced migrants. Although this issue must be urgently addressed at the global level (in fact, it is rightly underlined that climate change related problems cannot be efficiently tackled by States alone, since national measures aimed at environmental protection are subordinated to the need to protect national interests and priorities; Żuk et al., 2024), no effective solution was provided for under international law; apart from a general (though clearly binding) obligation on states to *use science in order to address all the damaging impacts of climate change*. Still, on the one hand, the international community failed to adopt a common approach to the problem (examples used in this study reflect the divide between the Global North and the Global South); importantly, on the other hand, some countries have initiated a paradigm shift as reflected in their policies.

For example, the US has recently introduced a bill aimed at addressing climate induced migration, following on from previous initiatives (i.e., Climate Displaced Persons Act-H.R.6455, 2024). Indeed, the bill provides for the protection of any person who is compelled to leave his habitual home due to "a climate-related environmental disaster" or "the interaction of a climate-related environmental disaster with other factors"; or is "unable to otherwise access a durable solution, such as local integration or safe and voluntary return" for similar reasons (see section 3). On this basis, the bill provides for resources and assistance to a delineated category of climate-induced migrants. Accordingly, it "authorizes the United States to address, through contributions to "multilateral initiatives and funds," permanent loss and damage faced by communities impacted by climate change as well as support community recovery and reconstruction (…)," although "It lacks clarity as to how admission will be allocated to members of a population from a vulnerable country who are variously internally displaced, in a third country, or physically present in the United States" (Perry and Schacher, 2023). In the same vein, an agreement was signed (on November 9, 2023) between Australia and Tuvalu, granting the possibility of permanent residency in Australia, for 280 Tuvaluans per year, i.e., 2.5 percent of the islands' population; while Australia committed to also assist Tuvalu to adapt *in situ* (Huckstep and Dempster, 2023). Although such policy measures are not without their critics (Huckstep and Dempster, 2023, also Clare, 2023), they show a (re) prioritization toward the protection of climate-induced migrants, and could serve as an example to be attempted elsewhere.

At the same time, the International Tribunal for the Law of the Sea (ITLOS) became the first international court –on 21 May 2024– to issue an advisory opinion on States' obligations in respect to climate change (Dunn, 2024). Importantly, two more advisory opinions are due to be published, putting the focus on the need to also protect the interests of the persons impacted by climate change: a first one on the obligations and principles that should guide the measures adopted by States to address involuntary human mobility, including when exacerbated by the climate emergency (by the Inter-American Court of Human Rights/IACHR), and a second one on the international law obligations of States to ensure the protection of the climate system for present and future generations (by the International Court of Justice/ICJ) (Dunn, 2024).

Modern polities appear to be realizing, albeit slowly, that two normative readjustments must be effected: *on the one hand* respect for human rights must be extended to climate induced migrants; *on the other hand*, that measures should be taken to address the realization that new types of threats to human rights may well be related to climate change. However, taking into account the scale of the challenges posed by climate change, one may argue that the international community seems to have also become conscious of the urgent need to transfigure the reservoir of goodwill and political rhetoric into concrete, precise and legally binding obligations on States and governments. Further concrete action is needed *inter alia* in order, (a) to avoid procastrinations delaying progress in the implementation of international environmental law treaties or related (e.g., CoP) decisions; (b) to address the absence of a clear and binding obligation on States to restore ecosystems following a climate disaster; and (c) to strengthen its commitment to establish the necessary obligations and mechanisms for the protection of climate induced (internal or international) migrants.

In order to do this, it is evident that the international community must principally enhance the *binding* measures guaranteeing the protection of climate induced migrants; notwithstanding, policy optimalities will be achieved if it is also committed to adopting the measures necessary for incorporating scientific information and tools that improve policymaking based on the knowledge that climate change is a threat of unprecedented importance and urgency which requires synergy of efforts at all levels.

Data availability statement

Publicly available datasets were analyzed in this study. This data can be found at: https://worldmigrationreport.iom.int/msite/wmr-2024-interactive/, https://www.internal-displacement.org/global-report/grid2024/, https://www.ipcc.ch/reports/.

Author contributions

AK: Writing – original draft. EG: Writing – original draft, Writing – review & editing. MP: Writing – original draft, Writing – review & editing.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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