Sandbags have been placed to protect the coast in Temwaiku, South Tarawa, Kiribati. Holding the line against climate hazards is often vital for some territories but may be maladaptive over the long run.

PHOTO: KADIR VAN LOHUIZEN/NOOR/REDUX

POLICY FORUM

Strengthen climate adaptation research globally

More international incentives and coordination are needed

By **Alexandre K. Magnan[1,2], Ariadna Anisimov[1], Virginie K. E. Duvat[2]**

The window of opportunity for climate adaptation action is closing fast because of warming and development trends (*1*). Yet efforts toward enhancing adaptation policy, implementation, and finance are not considered at adequate scale globally (*2, 3*). Scaling up such efforts requires substantial international investment, which we argue should include support for transdisciplinary adaptation research to enhance scientific foundations to feed into more effective policy engagement and funding for implementation. Here, we identify opportunities associated with three scientific frontiers: understand the potential for effective climate risk reduction (including understanding maladaptation, residual risk, and adaptation limits); assess systemic, cascading, and transboundary risks; and track adaptation progress.

The recent report of Working Group II (WGII) of the Intergovernmental Panel on Climate Change (IPCC) shows that even under a low emissions scenario aligning with the +1.5°C/+2°C temperature target, the world is on track to experience severe climate risks before the end of this century (*1*, *4*). It also reports widespread and substantial risk levels occurring at lower global warming levels than in previous assessments (*4*). In addition, it is estimated that by 2100, global climate risk will increase by two- to fourfold under 2°C and 4°C of global warming, respectively (*5*), and that half of humankind is living in areas that are highly vulnerable to climate change (*1*). These conclusions make the case that adaptation is no longer an option but an imperative for socioecological systems over this century and beyond.

Another element emphasized by the report is that besides being a national and local concern, adaptation is also a global responsibility. The United Nations Framework Convention on Climate Change (UNFCCC), the Adaption Fund, the IPCC report, and science and policy communities more broadly increasingly recognize that in many cases, localized adaptation decisions can have implications on distant places through, for example, supply chains, markets, or movements of people. Thus, implementing sound climate adaptation should ultimately be seen as a shared responsibility, both nationally and internationally, toward long-term socioeconomic well-being and equity.

One question therefore is how science can help address the adaptation challenge at multiple scales. Prior calls for adaptation research have emphasized the need to support improved knowledge on decision-making, vulnerabilities, forecasting, and action (*6*). Although these pleas contributed to boosting adaptation studies and raising the policy profile of the topic (in international negotiations, development assistance, and national to local policies), there is a need, we argue, to move a step further—first, because policies are not yet equipped to deal with emerging issues emphasized by the WGII report on understanding adaptation effectiveness, the risk of maladaptation, residual risks, adaptation limits, and compound and cascading risks, and second, because increasing and accelerating climate risks call for scaling up adaptation knowledge and policy impact. We thus need both more research and more coordination internationally.

UNDERSTAND EFFECTIVE CLIMATE RISK REDUCTION

The IPCC WGII report reinforces conclusions drawn from the 2019 Special Reports on Land and the Ocean and Cryosphere that societal adaptation can substantially decrease climate risk under all warming scenarios (*5*). Understanding the effectiveness of adaptation to reduce current and future climate risk is critical for at least two reasons: (i) assessing whether current adaptation efforts are sufficient or not in a context of increasing warming and (ii) identifying the room to maneuver in terms of risk reduction—for example, when comparing risk levels under low- and high-adaptation scenarios. Such knowledge is decisive to help set up adaptation policy targets at a given scale and hence structure and galvanize action across systems, stakeholders, and scales.

The IPCC WGII, however, raises three major concerns. First, the scientific literature still provides little evidence on effective risk reduction associated with the adaptation-related responses that are reported on the ground (*2*). This is partly inherent in risk reduction often needing time to become (or not) evident and measurable. Yet although there is knowledge on the observed outcomes of a wide range of actions that aim to reduce risk, assessing these outcomes in the future and under changing climate conditions remains difficult. The development of robust adaptation policies, however, requires such a forward-looking perspective.

Second, there are concerns about the increase of the risk of maladaptation, when measures implemented in the name of adaptation reveal counterproductive effects that lead to increasing long-term exposure and vulnerability to climate change. For example, engineered structures such as seawalls used

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to protect coasts reduce risks in the short term but can increase socioecological systems' exposure and vulnerability over time through, for example, the degradation of coastal environments (such as beach loss), the densification of built assets in newly "protected" areas, and the (false) idea that populations that live behind such structures are safe from coastal hazards. Lock-in effects are at work that insidiously reinforce climate risks in the medium to long term, and counteracting these processes must fully be part of any adaptation strategy.

Third, emerging forward-looking analyses involving various methods (climate modeling, socioeconomic projections, and expert judgments) and a mix of quantitative and qualitative findings suggest that ambitious adaptation cannot fully prevent a part of climate risk from manifesting, even at low levels of warming for some high-risk regions (*5*, *7*). This refers to the likely existence of residual risks—risks that remain despite adaptation—and adaptation limits, both topics that remain under-investigated within adaptation research (*2*).

As a result, policy-makers and practitioners still face major knowledge gaps on the context-specific potential effectiveness of a range of adaptation-related measures to reduce climate risk over the long run (*1*, *6*), including their potential counterproductive effects (maladaptation), the conditions under which adaptation will not be possible at all (adaptation limits), and the potential for unavoidable consequences (residual risks). One way to speed up things would be for the UNFCCC to call for the development of an IPCC Special Report on "Evidence of and enabling conditions for effective climate adaptation across scales" within the future Seventh Assessment Cycle (AR7). Concretely, that would mean a coalition of Parties to the UNFCCC and/or a formal decision at the 28th Conference of the Parties (COP28)—in 2023 and at the time of the first Global Stocktake on climate action—to put this proposal on the agenda of the scoping meeting of the AR7.

As shown with the IPCC 1.5°C report (*8*), Special Reports could serve as catalysts to raise awareness among policy-makers and funders about frontline research topics, accelerate the production of knowledge, and synthesize scattered scientific information. Our proposed AR7 Special Report could play such a role, for example, by investigating a series of real-world cases across regions and sectors, and/or undertaking assessments for representative territorial archetypes (such as middle-size cities, high mountains, urban atoll islands, and small farming areas) to foster a system-level understanding of effective adaptation.

Besides calling for more applied transdisciplinary research, we also call for a higher level of structuring of scientific efforts to ensure that consistent information is available at the global level. Although several scientific methods have started to emerge on assessing adaptation potential effectiveness, the risk of maladaptation, and adaptation limits, they are used on an individual study basis and are not applied to a wide diversity of sociogeographical contexts. Scaling up such efforts requires more coordination across methods and study contexts, together with a systematic stocktake of scientific advancements. This is definitely not a call for homogenizing scientific methods and neglecting the benefits of a diversity of approaches but for ensuring that multiple sources of scientific information can be brought together to support, for example, IPCC authors in their literature review effort. Yet an international platform on adaptation science is needed to do such coordination and, in collaboration with other institutions, forge closer ties at the science-policy interface.

Because setting up such a platform could take a long time and goes beyond the mandate of the IPCC, we do not advocate for inventing a new organization or institution but rather for building on existing initiatives such as the non-UN Global Adaptation Mapping Initiative or the UN World Adaptation Science Program, which are both in close relation with the IPCC. These initiatives started to organize knowledge (such as systematic literature reviews) and the research community (such as the biannual Adaptation Futures conference) but remain limited in scope and therefore in their ability to provide a singular platform for adaptation data, methods, case studies, and findings on what works or could work as well as under which conditions (such as social, economic, institutional, and environmental).

The associated near-term investment in time, money, and people is competing with the need for actual implementation of adaptation projects, but we argue that these costs will be vastly outweighed by the benefits that accrue over the long run. One example is how such a scientific platform could support UNFCCC policy discussions on Loss and Damage on a more regular basis and with a higher granularity than can the IPCC. Loss and Damage is a highly sensitive topic that touches on residual risks resulting from adaptation efforts that are not effective enough and from the reaching of adaptation limits, together with contentious issues about the attribution of observed impacts to climate change versus nonclimate drivers (*9*). Both increased and coordinated scientific information on various types of losses could be integral (i) to help structure scientifically informed international discussions based on ground-rooted data and (ii) to support the Santiago work program—established by UNFCCC in November 2021 to provide technical support, especially to developing countries—by either matching financial instruments with different types of losses and damages (such as noneconomic) or by developing relevant disbursement criteria. In the end, it will help buy time by targeting more effective action.

ASSESS CASCADING, COMPOUNDING, AND TRANSBOUNDARY RISKS

The IPCC WGII also emphasizes the need to consider cascading impacts; compounding risks (cumulative interactions between several risks and/or risk drivers); and transboundary risks across sectors, jurisdictions, and population groups, both within and across borders (*10*). These processes will combine to generate snowball effects and in turn substantially influence the magnitude, life span, rate of emergence, and spatial spreading of individual risks across systems (*4*). This will likely lead to severe climate risks being higher, lasting longer, and occurring both sooner and at larger scales than assessed in the IPCC WGII report. Another challenge therefore touches on the need for adaptation policies to be better prepared to anticipate and manage systemic risks. In that respect, the UNFCCC could encourage Parties to systematically include a new component or chapter into their official adaptation documents (National Adaptation Plans and Adaptation Communications) to describe the cascading, compounding, and transboundary risks that they are concerned with, as well as strategies to tackle them.

In practice, such a proposal raises numerous questions—for example, on Parties' willingness to consider complex and nondomestic risk issues or their capacity to undertake additional work while already burdened by UNFCCC reporting processes. However, early signs do exist of better policy consideration of cascading, compounding, and transboundary risks—for example, in the UK Climate Change Committee's independent risk assessment in 2021. Analytical frameworks and tools are also emerging on the physical, ecological, and human cascading and compounding consequences of climate change (including environmental and societal tipping points). Expert judgment methods, for example, are used to map risk interactions, often in a rather qualitative way (*4*). But as for emerging studies on assessment of potential effectiveness, maladaptation, limits, and residual risks, these remain topic-limited (such as on agricultural commodities and international trade) and lack higher-level structuring in terms of

method and sharing of findings, as well as policy impact. The Adaptation Without Borders Initiative offers an opportunity toward such a scaling up and structuring process; it started to highlight cases of transboundary risks and governance (including assessment methods) and to engage with policy partners from UNFCCC and several regions (such as Hindu Kush Himalaya).

TRACK ADAPTATION PROGRESS

The IPCC WGII undertook a monumental review of the scientific literature (*2*, *4*) to emphasize, for example, that adaptation-related responses are on the rise worldwide and are rather behavioral (for example, improvement of homes and changes in crops) than technical or institutional. In parallel, during COP26 in Glasgow in 2021 the international climate policy community called for enhancing "understanding of [...] the methodologies, indicators, data and metrics, needs and support needed for assessing progress towards [adaptation globally]" (*11*). A global picture of adaptation efforts is foundational to inform the 5-year Global Stocktake cycle under the UNFCCC through answering two important questions: (i) whether we are collectively on track to adapt to, for example, a 1.5°C world (ii) and how to define more precise global-level adaptation targets that will drive, as seen for mitigation, more ambitious national adaptation policies in a way that they are also consistent with a global perspective.

To date, however, no formal, internationally agreed-on process is in place to assess adaptation progress globally and as comprehensively as possible (*12*). Policy-oriented initiatives exist—such as the Adaptation Gap Report (AGR) of the United Nations Environment Program (UNEP) (*3*)—among others, that deliver regular assessments of global adaptation gaps and progress. However, these assessments usually rely on a limited type of information (for example, mainly from policy documents and international donors in AGR), which makes their findings relatively specific in terms of the adaptation dimension(s) they consider (for example, national policy in AGR). A more comprehensive understanding of adaptation is necessary, which calls for gathering information beyond quantitative metrics, beyond policy and scientific documents, and at multiple scales. To this end, a scientific international initiative to track adaptation progress globally is needed that matches several criteria: be based on innovative scientific methods (such as a combination of modeling and expert judgments) and procedures (peer reviewing); overcome the usual barriers of quantitative data availability (*6*) by bringing together multiple sources of information (also qualitative, gray literature, and traditional knowledge); be distinct from the UNFCCC process to ensure independent outcomes; and at the same time, be policy-relevant enough to feed the UNFCCC discussions and stocktake(s). Some initiatives are emerging, such as the Global Adaptation Progress Tracker (GAP-Track), that offer potential relevant scientific architectures, provided that their scope is broadened (for example, for the GAP-Track, from a coastal focus to a wider spectrum of human settlements such as cities, rural systems, and mountains).

FINANCING ADAPTATION SCIENCE

The gap is widening between the estimated adaptation needs and documented finance allocated to adaptation (*3*). Whereas it is clear that more funding for adaptation action on the ground should remain a global priority (*11*), we argue for enlarging the scope of "climate finance"—originally centered around providing support to developing countries—to accelerate transdisciplinary research. Social sciences in particular need to be better integrated into climate science, which being historically focused on physical and natural sciences provides limited insights on critical dimensions of adaptation (*6*), such as risk perceptions, the societal acceptability of policies and measures, and the role of socioeconomic equity. Our call for more research and more coordination internationally can help.

> **"...implementing sound climate adaptation [is] a shared responsibility, both nationally and internationally..."**

First, a strong research component should be systematically included into each adaptation project funded by development agencies and international funding bodies (the Green Climate Fund, for example). This would consist of an independent, transdisciplinary scientific monitoring of the project's implementation and results and assessment of the potential effectiveness of actions undertaken (including tracking), the risk of maladaptation, and the potential for residual risks and adaptation limits. The French Development Agency, for example, has started to explore this process by including a "Knowledge" component into its Adapt'Action Facility mechanism. In addition to providing feedback to funders and practitioners, this would represent a distinct opportunity to further engage local researchers, especially in the Global South, to better account for local realities at the crossroads of climate and development.

Second, a range of funding opportunities for adaptation research projects are already in place, both by national research agencies (*6*) and nonstate and nonpublic actors. For example, the AXA Research Fund, BNP-Paribas Foundation, and Rockefeller Foundation have become more active in identifying climate solutions (such as technological). These opportunities are critical to support research on the ground and new knowledge but, because they are project-oriented, are not well suited to support global-scale research structuring. One option is therefore to create a shared fund that is supplied by multiple organizations and specifically dedicated to the development of such international research structuring initiatives, starting with existing ones such as the Global Adaptation Mapping Initiative or the Gap-Track, just to name a few.

In addition to highlighting new scientific topics, the IPCC WGII warns that the solution space is shrinking with warming (*1*, *13*), so that a sharp acceleration in action is urgently needed. This raises multilevel challenges that the international community could help address, we argue, by setting up the enabling scientific conditions for the whole adaptation ecosystem (scientists, decision-makers, practitioners, and funders) to design and implement robust adaptation policy pathways. ■

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