

# Understanding and quantifying the Loss and Damage policy space

## IIASA & CMCC COP29 insight

Reinhard Mechler,<sup>1</sup> Elisa Calliari,<sup>1,2</sup> Stefan Hochrainer-Stigler,<sup>1</sup> Massimo Tavoni<sup>2</sup> and Matteo Calcaterra<sup>2</sup>

<sup>1</sup> International Institute for Applied Systems Analysis (IIASA), Austria

<sup>2</sup> Euro-Mediterranean Centre on Climate Change (CMCC), Italy

---

## Summary

- Loss and Damage (L&D), after years of slow progress, is now a fast-moving area of climate policy. L&D broadly refers to international support for climate impacts and risks in particularly vulnerable developing countries that are *unavoided* and linked to *unavoidable* increases in climate hazards.
- Given vague definitions for the underlying concept and absence of clearly established methodologies, there are large unknowns and uncertainties regarding policy formulation and the size of L&D funding needs.
- Building on a climate risk analytical perspective we present a climate policy framework for considering gaps and actions on climate mitigation, adaptation, protection and response to help charting out the policy space for Loss and Damage.
- The framework and supporting evidence show how Loss and Damage-related funding can support actions to address residual impacts and risks including social or financial protection mechanisms, contingency funds for post-disaster recovery, the upgrading of social safety nets through climate-adaptive social protection (including public works), and making health care systems resilient to climate shocks.
- Using state of the art economic impact science we further present estimates for the *unavoided* residual impacts of climate change and related L&D funding needs.
- Considering the geographical distribution of impacts and different historical responsibility principles, possible contributions and entitlements to L&D funding can be established.
- Our estimates of current (2025) funding needs for residual impacts amount to a range of US \$128–937 billion for global economic climate impacts of US \$ 385–737 billion. This range is larger, but of similar magnitude as for the other very few economic assessments in the literature.
- The estimates show how L&D funding needs require flows from high/upper middle income to mid/low income countries proportional to ghg (CO<sub>2</sub>) emission responsibility. Ghg responsibility start dates (1850, 1990, 2015) affect funding shares between high and upper middle income states, but not mid/ low income country recipients of the fund.
- With ongoing UNFCCC deliberations around L&D in the context of the New Collective Quantified Goal on Climate Finance (NCQF), the steps towards the operationalisation of the Fund for Responding to Loss and Damage and the launch of the first High Level Dialogue on complementarity and coherence at COP 29, our suggestions seek to support coherence in climate policy and focus attention to the needs of the most vulnerable.
- Further research and discussion will help to more clearly define L&D funding needs and finetune estimates of economic and non-economic losses and damages.

## Progress on Loss and Damage

New work by IIASA and CMCC leverages developments in climate science, economics and climate policy to bolster evidence for the rationale and funding needs associated with Loss and Damage (L&D) and to inform international negotiations, including on the operationalisation of the Fund for Responding to Loss and Damage (FRLD), the launch of the High Level Dialogue on complementarity and coherence, and discussions around L&D in the New Collective Quantified Goal on Climate Finance (NCQF).

L&D has emerged as a key area of climate policy over the last decade. New funding arrangements, including the FRLD, were agreed at COP27 and operationalised at COP28. Initial pledges to the FRLD have so far exceeded USD 850 million. Yet vague definitions of the underlying concept and an absence of clearly established assessment methodologies have hampered a full understanding of L&D funding needs.

The Paris Agreement recognizes the importance of “averting, minimizing, and addressing loss and damage” in the most vulnerable countries where averting refers to reducing the risk of L&D in the first place through mitigation, and minimizing through climate change adaptation and risk reduction, leaving a need to address losses and damages where they cannot be prevented. The IPCC (2022) distinguishes between “Loss and Damage” (capital letters, singular) when referring to political debate under the United Nations Framework Convention on Climate Change (UNFCCC) and the Paris Agreement and “losses and damages” (lowercase letters, plural) to refer broadly to (observed) impacts and (projected) risks that are *unavoided* by mitigation and adaptation as well as linked to *unavoidable* increases in multiple climate

hazards to both ecosystems and human communities (see IPCC, 2022).

Although of increasing saliency, quantification of L&D needs remains extremely limited in number, methodology and scope. There have been very few estimates of global L&D funding needs. UNEP (2023) reports a range of about US \$200 billion to 4 trillion with different geographical coverage and referring to different time periods. Only one study by Markandya & González-Eguino (2019) reported residual economic risks globally.

## Charting out a policy space for L&D

Building on a climate risk analytical perspective, Mechler et al. (2023) propose a climate policy framework for considering actions and gaps on climate mitigation, adaptation, protection and response to help charting out the policy space for L&D. The proposal is to enhance climate policy coherence around L&D by employing a risk-layering framework. This approach, used in disaster and climate risk management, involves coordinating investments into risk management and adaptation by reducing risks to an acceptable level, providing risk finance and insurance for residual risks, and engaging in risk retention for residual risks that are neither reduced nor transferred (see also Mechler and Deubelli et al., 2021).

Figure 1 illustrates how various gaps related to UNFCCC policy areas, risk responses, and resilience outcomes intersect. Support for closing gaps for the most vulnerable countries via L&D (through the FRLD and other L&D funding) would thus largely mean to attend to protection and response gaps and to manage impacts and risks that are *unavoided* and those that are linked to *unavoidable* increases in climate hazards. Actions for protection gaps would include, among others, social or

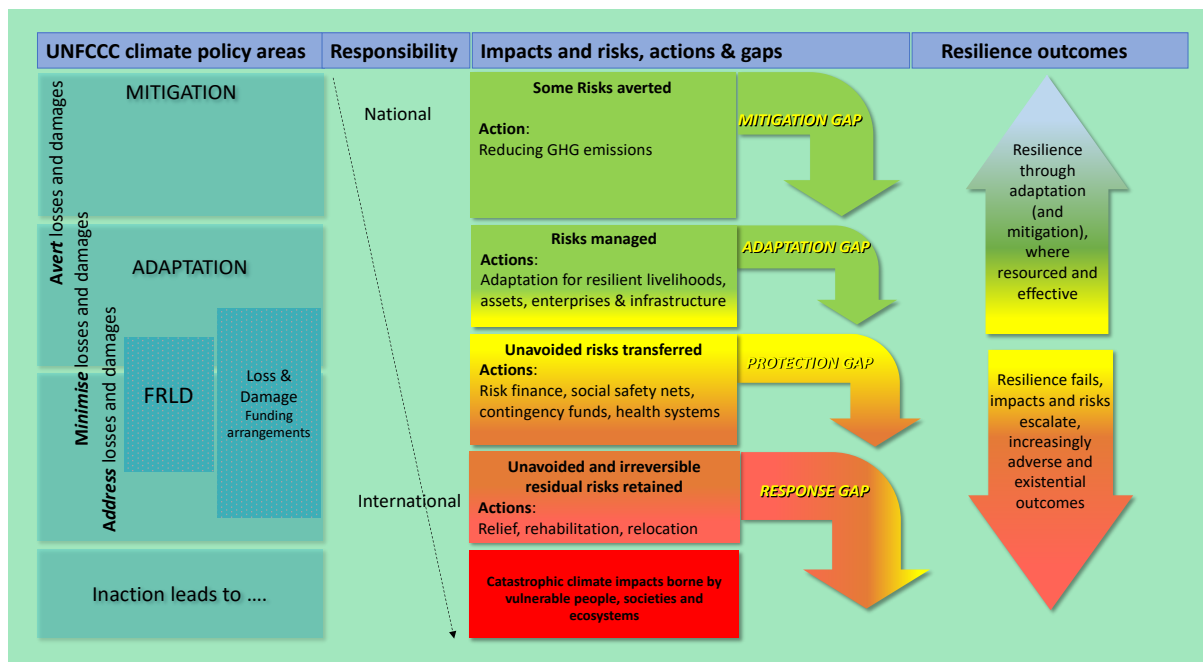


Figure 1: Conceptualising global climate policy for attending to climate policy gaps incl. the policy space for Loss & Damage

financial protection mechanisms, such as social safety nets and insurance. Yet, there are severe shortcomings in contingency funds for post-disaster recovery, the upgrading of social safety nets through climate-adaptive social protection (including public works), and in making healthcare systems resilient to climate shocks. Without effective and inclusive risk transfer, other risk financing and social protection mechanisms, vulnerable populations face a *climate protection gap* with extensive further social implications. E.g., coastal settlements are already threatened by sea level rise, mountain communities face glacial lake outburst floods, low-lying areas experience more severe cyclones, coastal fisheries suffer from ocean acidification, and homes and forests are at enhanced risk from forest fires (IPCC, 2022).

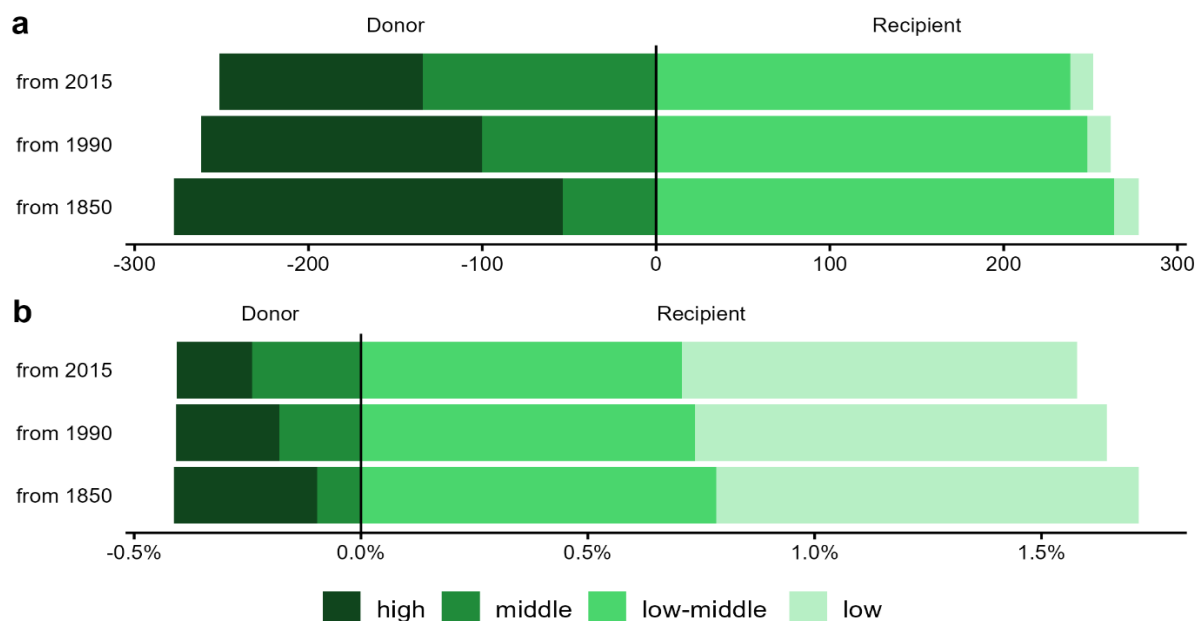
## Quantifying L&D needs

There is increasing empirical evidence that the economic costs of climate change are substantial. While global heating and extreme weather affect countries and communities worldwide, those regions least responsible for climate change and with the fewest resources

to adapt are hit hardest. Progress in empirical estimates have led to an improved understanding of how climate change affects economic activities and has consistently shown that climate risks - even from a purely economic perspective - are very significant and highly differentiated between countries and regions; thus there is an important degree of economic inequality attributable to global warming (Burke et. al., 2015; Kotz et. al, 2024).

Research led by CMCC in collaboration with IIASA and the Potsdam Institute for Climate Impact Research (PIK) (Tavoni et al., 2024) explores novel ways of quantifying the economic costs of L&D by combining climate economics insight on damage quantification with principles of historical responsibility. The study provides estimates of current *unavoided* economic impacts of climate change and their geographical distribution using evidence from both bottom-up and top-down methodologies. It couples those estimates with different historical responsibility principles to compute possible contributions and entitlements to L&D funding (see fig. 2).

The analysis shows how L&D funding needs require flows from high/upper middle income



**Figure 2: Contributions to L&D funding for the year 2025 for different income-level regions and responsibility principles.** Distribution of the L&D fund between donors and recipients for 3 different starting dates for historical responsibility (1850, 1990, 2015). Countries are grouped based on their income level (low, low-middle, upper-middle and high, based on the most recent World Bank classification). The upper panel reports levels of funding in current US \$ billions, and the lower panel as a percentage of country group income. Data source: Tavoni et. al 2024, averaged across three economic damage functions.

to mid/low income countries proportional to different considered ghg (CO<sub>2</sub>) emission responsibility start dates (1850, 1990, 2015). These dates affect the funding shares for major polluters including high and upper middle income states, but not those for low income countries. Estimates of L&D funding needs for residual impacts for 2025 amount to a range of US 128–937 billion for total global economic climate impacts of US \$ 385–737 billion. Given the variety of methods employed, these estimates present a wider range, yet similar magnitude estimates as the only other comprehensive study conducted five years back (Markandya&González-Eguino, 2019), which reported residual economic impact estimates for non-Annex I countries with a range of \$116–435 billion for 2020 and \$290–580 billion for 2030 (in 2005 USD).

The dynamic understanding of responsibility adopted in the study provides novel insights on how growing needs for L&D funding may be met, particularly considering that the current support architecture under the UNFCCC and

Paris Agreement recognizes that funding for L&D is a global effort that requires contributions from a variety of sources. At the same time, it shows how resources must be directed from polluters to the most vulnerable developing countries.

## Conclusions

The research by IIASA and CMCC informs the L&D debate in two important ways. First, the policy framework presented offers an entry point for a comprehensive risk management and finance approach that can inform international Loss and Damage deliberations by highlighting synergies with adaptation, social and financial protection and impact responses as a way to ensure coherence in climate policy and to comprehensively pay attention to the needs of the most vulnerable. This can provide insights for L&D deliberations at COP 29 in November in Azerbaijan, including for the operationalization of the Fund for Responding to Loss and Damage, the Launch of the High-level Dialogue and the NCQF

discussions on a post-2025 global goal on climate finance for supporting climate action in developing countries.

Second, the proposed methodological L&D needs funding approach coupling empirical and modelling estimates of climate change residual impacts with different historical responsibility principles provides innovative insights for delineating possible contributions and entitlements to L&D funding. Our estimates amount to US \$395 [128–937] billion and show how L&D funding needs require flows from high/upper middle income to mid/low income countries across various principles of historical responsibility.

Our research also calls for an expanded research agenda. Several climate-related economic risks are still unquantified, and the

extent to which adaptation can limit these impacts is not fully understood. Moreover, existing estimates typically do not capture non-economic impacts on humans and ecosystems, as well as non-use and non-anthropogenic values of natural capital, which are relevant, especially in developing countries. Further research is needed for generating qualitative and quantitative evidence also with respect to the increasingly existential climate risks and limits to adaptation.

IIASA and CMCC stand ready to further collaborate with policy, civil society and research to generate further relevant evidence and insight for informing Loss and Damage deliberations.

---

## Further information

- Burke, M., Hsiang, S. M. & Miguel, E. (2015). Global non-linear effect of temperature on economic production. *Nature* 527, 235–239. <https://doi.org/10.1038/nature15725>
- Calliari, E. & Ryder, B. (2023). What Does Loss and Damage Mean at the Country Level? A Global Mapping Through Nationally Determined Contributions. *Global Environmental Politics* 23 (3) 71-94. [https://doi.org/10.1162/glep\\_a\\_00725](https://doi.org/10.1162/glep_a_00725)
- IPCC (2022). Summary for Policymakers [H.-O. Pörtner, D.C. Roberts, E.S. Poloczanska, K. Mintenbeck, M. Tignor, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem (eds.)]. In: *Climate Change 2022: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Sixth Assessment Report of the Intergovernmental Panel on Climate Change* [H.-O. Pörtner, D.C. Roberts, M. Tignor, E.S. Poloczanska, K. Mintenbeck, A. Alegría, M. Craig, S. Langsdorf, S. Löschke, V. Möller, A. Okem, B. Rama (eds.)]. Cambridge University Press, Cambridge, UK and New York, NY, USA, pp. 3–33, <https://doi:10.1017/9781009325844.001>
- Kotz, M., Levermann, A. & Wenz, L. (2024). The economic commitment of climate change. *Nature* 628, 551–557 (2024). <https://doi.org/10.1038/s41586-024-07219-0>
- Markandya, A., González-Eguino, M. (2018) Integrated assessment for identifying climate finance needs for loss and damage: a critical review. In: Mechler, R., Bouwer, L., Schinko, T., Surminski, S., Linnerooth-Bayer, J. (eds). *Loss and damage from climate change. Concepts, methods and policy options*. Springer, Cham, pp. 343–362. [https://link.springer.com/chapter/10.1007/978-3-319-72026-5\\_14](https://link.springer.com/chapter/10.1007/978-3-319-72026-5_14)
- Mechler, R. & Deubelli, T.M. (2021). Finance for Loss and Damage: a comprehensive risk analytical approach. *Current Opinion in Environmental Sustainability* 50, 185-196 <https://pure.iiasa.ac.at/id/eprint/17239/>
- Mechler, R., McQuistan, C. & Rosen Jacobson, B. (2023). [Falling through the gaps: how global failures to address the climate crisis are leading to increased losses and damages](https://www.zurichfloodresiliencealliance.org/publications/falling-through-the-gaps-how-global-failures-to-address-the-climate-crisis-are-leading-to-increased-losses-and-damages). Zurich Flood Resilience Alliance
- Tavoni, M., Andreoni, P., Calcaterra, M., Calliari, E., Deubelli, T., Mechler, R., Hochrainer-Stigler, S. & Wenz, L. (2024). Economic quantification of Loss and Damage funding needs. *Nature Reviews Earth & Environment*. <https://doi.org/10.1038/s43017-024-00565-7>