Chapter 4
The Risk and Policy Space for Loss and Damage: Integrating Notions of Distributive and Compensatory Justice with Comprehensive Climate Risk Management

Thomas Schinko, Reinhard Mechler and Stefan Hochrainer-Stigler

Abstract The Warsaw Loss and Damage Mechanism holds high appeal for complementing actions on climate change adaptation and mitigation, and for delivering needed support for tackling intolerable climate related-risks that will neither be addressed by mitigation nor by adaptation. Yet, negotiations under the UNFCCC are caught between demands for climate justice, understood as compensation, for increases in extreme and slow-onset event risk, and the reluctance of other parties to consider Loss and Damage outside of an adaptation framework. Working towards a jointly acceptable position we suggest an actionable way forward for the deliberations may be based on aligning comprehensive climate risk analytics with distributive and compensatory justice considerations. Our proposed framework involves in a short-medium term, needs-based perspective support for climate risk management beyond countries ability to absorb risk. In a medium-longer term, liability-based perspective we particularly suggest to consider liabilities attributable to anthropogenic climate change and associated impacts. We develop the framework based on principles of need and liability, and identify the policy space for Loss and Damage as composed of curative and transformative measures. Transformative measures, such as managed retreat, have already received attention in discussions on comprehensive climate risk management. Curative action is less clearly defined, and more contested. Among others, support for a climate displacement facility could qualify here. For both sets of measures, risk financing (such as 'climate insurance') emerges as an entry point for further policy action, as it holds potential for both risk management as well as

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compensation functions. To quantify the Loss and Damage space for specific countries, we suggest as one option to build on a risk layering approach that segments risk and risk interventions according to risk tolerance. An application to fiscal risks in Bangladesh and at the global scale provides an estimate of countries' financial support needs for dealing with intolerable layers of flood risk. With many aspects of Loss and Damage being of immaterial nature, we finally suggest that our broad risk and justice approach in principle can also see application to issues such as migration and preservation of cultural heritage.

Keywords Climate justice · Loss and Damage space · Transformative measures Curative measures · Climate risk management

4.1 Tackling Climate-Related Risk in a Contested Policy Context

The 19th conference of the Parties (COP 19) in Warsaw in 2013 saw the establishment of the "Warsaw International Mechanism for Loss and Damage" (UNFCCC 2014). With Article 8 of the Paris Agreement (UNFCCC 2015a) Loss and Damage (L&D) can now be regarded as a sort of "3rd pillar of the work under the UNFCCC in addition to mitigation and adaptation" (Verheyen 2012). The terrain is extremely contested with highly-at risk countries of the global South (such as those of the Alliance of Small Island States, AOSIS) demanding compensation payments for *actual* past, present and future incurred losses and damages due to climate change, while Annex I countries are unwilling to consider such framing and any related actions (see introduction by Mechler et al. 2018; chapters by Calliari et al. 2018; chapter by Wallimann-Helmer et al. 2018). Yet, these parties have shown willingness to support climate change adaptation (CCA) and have supported 'good' risk management over the years to tackle *potential* loss and damage, as evidenced by intense debates on moral responsibility that preceded the approval of the Sendai Framework of Action (SFA) in March 2015. Interestingly, this discussion also saw heated debate as developing countries started to frame their interventions around the common, but differentiated responsibility logic, which has been fundamental for the UNFCCC discussion (Mysiak et al. 2015).

Liability and compensation on the one hand, and support for disaster risk management plus insurance on the other hand remain key negotiation positions for the parties. The divergence in perspectives (see also chapter by James et al. 2018) has led to difficult negotiations for the Executive Committee, which was established in 2015 to support the implementation of an informational work programme. Currently, the work programme somewhat balances the two perspectives without explicitly referring to justice and equity principles (more on the politics behind L&D can be found in the chapter by Calliari et al. 2018).

The science behind climate-related risks relevant for the L&D debate is equally complex. It has made great leaps forward with IPCC's SREX and IPCC's Working Group II reports as well as the UNGAR publications, which discuss climate and non-climate drivers of climate-related risk, the role of uncertainty, the role of attribution and the relevance of climate risk management (CRM) (IPCC 2012, 2013, 2014; UNISDR 2015). Overall, the science shows that, while anthropogenic climate change indeed amplifies intensity, frequency and duration of many hazards, a clear causal link from anthropogenic CO_2 emissions as a driver of risk to quantified socioeconomic risks cannot be established, and that therefore a principle of strict liability cannot (yet) be applied to climate risk (for more details on the frontiers in science regarding L&D see the chapters Bouwer 2018; James et al. 2018 and Lopez et al. 2018). In this context, Mechler and Schinko (2016) proposed a policy framework that builds on recent IPCC framing and evidence on climate-related risk, and Schinko and Mechler (2017) suggested to apply recent insights from CRM, an approach that strives for linking disaster risk reduction (DRR) and CCA agendas under one umbrella (see Schinko et al. 2016) to L&D. The authors argued that a better understanding of climate-related disaster risk and risk management can inform effective action on CCA and point a way forward for L&D policy as well as practice.

This chapter takes this proposition forward to the L&D debate and suggests to find a balance between notions of compensatory and distributive justice. While the compensatory justice notion's scope is distributing responsibilities in light of compensatory reasons and liability, the notion of distributive justice understands L&D as undeserved harm demanding redistribution to even out this unfairness (see also chapter by Wallimann-Helmer et al. 2018; Dellink et al. 2009 on the fair distribution of CCA costs). As a principle of strict liability cannot yet be applied to climate-related risk, we suggest an actionable way forward for the deliberations under the WIM based on the concept of CRM, which allows for an alignment of distributive and compensatory justice over time. The approach involves in a short-medium, needs-based perspective, international support for risk management beyond individual countries' ability to cope with climate-related risk; in a medium-longer term, rights-based perspective, we particularly argue for a strong consideration for liabilities attributable to human induced climate change. The discussion can be integrated towards a principled framework for identifying the space for Loss and Damage composed of curative and transformative measures.

As another key element to operationalise CRM in the context of L&D in practice, we put forward 'risk layering' as an actionable concept of risk and risk management (Mechler et al. 2014). This concept involves identifying efficient and acceptable interventions based on recurrence as well as severity of climate-related risks. For example, for flood risk, this would mean identifying physical flood protection to deal with more frequent events, considering risk financing for infrequent disasters as well as relying on public and international compensation for extreme catastrophes. Risk layering overall points towards considering risk comprehensively as determined by climatic and non-climatic factors as well as considering portfolios of options that manage risks today and in the future.

The further discussion in this chapter is organised as follows: Sect. 4.2 provides a short definition of L&D and aims at identifying major building blocks of a framework for L&D. Section 4.3 takes this discussion forward, and based on our three building blocks identifies the risk and policy space for Loss and Damage. The concept of risk layering based on risk-based modelling is put forward as a method for quantifying the Loss and Damage space in Sect. 4.4, which is followed by some short conclusions.

4.2 Building Blocks of a Principled Framework for Loss and Damage

Many analysts and parties have argued that the WIM is to deal with climate-related risks 'beyond adaptation' when coping capacities of communities and countries are exceededv (see e.g. Verheyen 2012). This is also reflected in what the parties to the UNFCC acknowledge in decision 2/CP.19 when they state that L&D "includes, and in some cases involves more than, that which can be reduced by adaptation" (UNFCC 2014). Beyond this consensus, little common ground exists and particularly ethical aspects have been the elephant in the room ever since the early stages of the debate on L&D. The following discussion aims at overcoming the ethical challenges involved in the discourse by referring to the debate via notions of climate justice and a CRM perspective (see also the chapter by Wallimann-Helmer et al. 2018 for more detailed exploration of the ethical challenges in the debate).

Defining Losses and Damages
Climate-related risks considered in the Loss and Damage discussion are associated with sudden-onset extreme events, such as flooding and cyclones, and slow-onset impacts including sea level rise and melting glaciers (see Fig. 4.1).

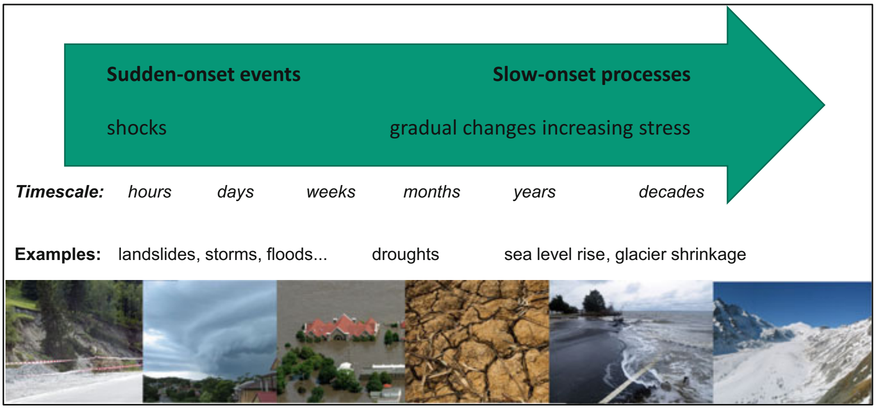

Fig. 4.1 Characterisation of climate-related risks relevant for Loss&Damage. Based on Huggel et al. (2016). *Pictures Source* Wikimedia Commons

Table 4.1 Classifying loss and damage

Avoided	Unavoided	Unavoidable
Avoidable loss and damage that can and will be avoided by climate change mitigation and/or adaptation measures	Avoidable loss and damage that will not be addressed by further mitigation and/or adaption measures, even though the avoidance would be possible. Financial, technical and political constraints as well as case-specific risk preferences narrow down the adaptation space	Loss and damage that cannot be avoided through further mitigation and/or adaptation measures, e.g. loss and damage due to slow onset processes that have kicked-off already, such as sea level rise, and extreme event risk where no adaptation efforts would help preventing the physical impacts

Source Table based on Verheyen and Roderick (2008)

While there is no official definition, losses in this context have been associated with irreversibility, e.g. fatalities from disasters or households stuck in poverty traps post-event, while damages have been referred to as impacts that can be rectified in principle. A useful distinction made that we build on has been between avoided, unavoided and unavoidable loss and damage (Verheyen and Roderick 2008) (see Table 4.1). In the literature, this same distinction has also been discussed with regard to whether climate-related impacts *cannot* or *will not* be addressed by mitigation or adaptation (cf. Mace and Verheyen 2016).

An example for *unavoidable* impacts or loss and damage that *cannot* be addressed either by mitigation or adaptation are extreme event risks where no adaptation efforts would help preventing the physical damage (Verheyen and Roderick 2008). A reason that some adaptation measures *will not be taken* or losses and damages remain *unavoided* is that actors may be subject to socio-economic constraints, especially international financing, and/or implementation constraints, although at least in theory these measures could have been taken (Chambwera and Mohammed 2014). Further constraints to adaptation planning and implementation comprise a lack of technological or knowledge resources and institutional characteristics that impede action.

4.2.1 Risk Identification: Analytics for Defining Avoidable and Unavoidable Losses and Damages

Over the last few years, with consequences of climate change becoming visible on all continents and in all oceans (IPCC 2014), assessments of climate change impacts have changed in focus from an initial analysis of the problem to the assessment of actual observed and potential future impacts, and finally, to the consideration of specific risk analytical methods to assess and manage future increases in risks. Originally focussed on incremental risk induced by anthropogenic climate change to identify dangerous levels of global risk (IPCC's five reasons for concerns), a risk perspective has prominently gained traction in recent IPCC reports where climate risk at different scales has been considered to be both shaped by natural climate variability and climate change, as well as by socioeconomic exposure and vulnerability. This evolved framing has opened doors for considering DRR as an important part of climate adaptation and lead to novel considerations organised around CRM, involving the management of total climate-related risk including any current adaptation deficits (Jones et al. 2014).

To inform thinking and action on CRM, a sort of 'climate risk language' has been developed by IPCC's working group II in its 5th assessment report (IPCC 2014). In doing so, working group II has built on IPCC's multiple lines of evidence philosophy, including collating empirical evidence on impacts and risks with information on adaptation options, and the modelling of future risks, as well as using expert judgment. The IPCC report succinctly summarises climate risks and the potential (as well as the limits) for adaptation for key risks and three time steps (present, near- and long-term 2 and 4 °C).

While adaptation constraints or barriers are defined as "factors that make it harder to plan and implement adaptation actions," an adaptation limit is "the point at which an actor's objectives or system's needs cannot be secured from intolerable risks through adaptive actions." (Klein et al. 2014) Furthermore, soft and hard limits to adaptation can be distinguished. The latter concept describes limits where no adaptive actions are possible to avoid intolerable risks, while in the former concept adaptive action might be possible in the future but no measures are currently available (IPCC 2014). The distinction between barriers and limits to adaptation as well as between soft and hard limits is coherent in theory, yet many difficulties might arise in operationalising it in practice. What determines when a limit is breached and who decides what the limits are? For example, Fig. 4.2 visualizes risks from sea level rise and high-water events as well as the corresponding adaptation potential in Small Island States. Building on the identification of key hazard drivers, sea level rise and cyclones interacting with high tide events, it finds the level of risk, essentially for coastal flooding, to currently be at medium levels and increasing with future warming to very high levels, particularly for the 4 °C warming scenario. While the risk bar, which is the product of the IPCCC's meta-analysis of available literature on climate-related risks in SIDS, shows overall risk (given adaptation actions taken), this visualization also teases out the potential for additional adaptation efforts in terms of further reducing risk.

IPCC's analysis applied to key world regions shows that the potential for adaptation is large for many regions and suggests that many risks are avoidable (although actions are not yet fully implemented thus defining a soft adaptation limit). Yet, for some regions and risks (particularly in natural systems) and at higher levels of warming, limits to adaptation are found to be reached, and these climate-related risks may become unavoidable (see chapters by Handmer and Nalau 2018; Haque et al. 2018; van der Geest et al. 2018; Landauer and Juhola 2018). An example is the bleaching of tropical coral reefs beyond 1.5/2 and 4 °C, where no options for adaptation exist (hence defining a hard limit to adaptation) (Magrin et al. 2014).

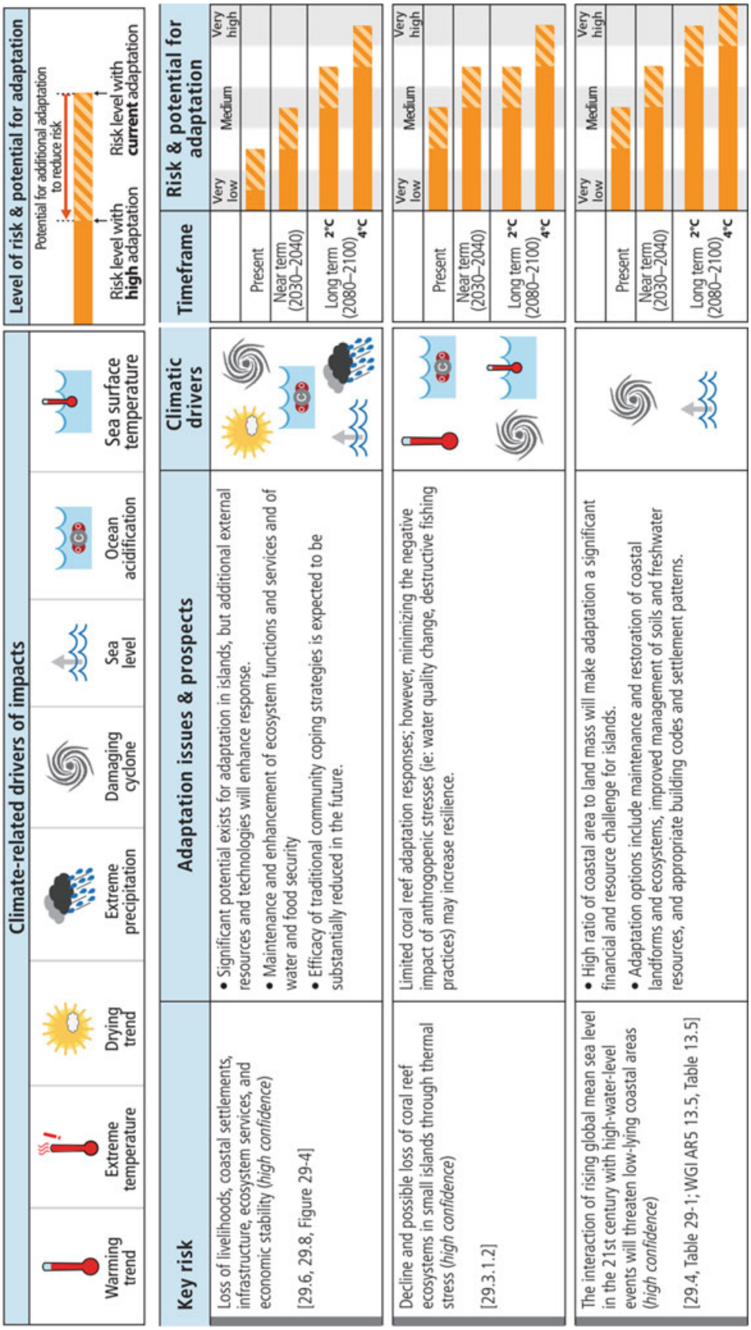

Fig. 4.2 Selected key risks and potential for adaptation for small islands. *Source* Nurse et al. (2014), p. 1635

4.2.2 Climate Attribution of Unavoidable Losses and Damages: Establishing a Role for Climate Justice

Ethical considerations in the form of questions regarding justice and fairness have played a key role in the policy and academic discourse on climate change (see e.g. Brown et al. 2006; Gardiner 2004a, b, 2006; Jamieson 1992, 2001, 2005; Ott 2004; Posner and Weisbach 2010; Shue 1992, 1993, 1999; Singer 2002, 2006; Vanderheiden 2008; chapter by Wallimann-Helmer 2018) ever since the beginning of the UNFCCC process, prominently exemplified by the principle of common but differentiated responsibilities in the Rio Declaration (United Nations 1992, Article 3.1).

For climate change mitigation and adaptation the discourse has largely circled around distributive justice (Grasso 2007; Posner and Weisbach 2010). In the mitigation domain different principles of distributive justice, applicable to the sharing of mitigation burdens have been discussed (Klinsky and Dowlatabadi 2009; Vanderheiden 2008). Due to inertia in the climatic system, no matter how effective global GHG mitigation efforts turn out to be, humanity will be faced with risks due to climate change that have direct and indirect (e.g. through ecosystem services) impacts on human welfare and which will require substantial adaptation efforts (IPCC 2012, 2014). The justice debate in the adaptation domain has thus centred on the question of how the costs (and benefits) of adaption should be distributed across countries (Adger et al. 2006; Dellink et al. 2009; Paavola and Adger 2006).

With the L&D debate, another notion of climate justice has now formally entered the international climate policy scene: compensatory justice. Basically two kinds of justice are especially applicable in the context of L&D (see chapter by Wallimann-Helmer et al. 2018). Forward-looking contexts are concerned with distributive justice, especially when distributing the risks of damages that cannot be adapted to. Backward-looking contexts are concerned with compensatory justice, especially in legal or procedural attributions of responsibility and liability. Compensatory justice suggests that it is those agents who primarily caused climate change who should compensate the agents which are experiencing losses and damages due to climate change without having substantially contributed to the problem themselves. This in turn implies that the agents who are not responsible for climate change are given a right for compensation by the agents who are found responsible and hence liable for particular risks that climate change increases the likelihood for (i.e. the outcome). Distributive justice (based on the ability to pay principle) suggests that it is those agents who are able or have the capacity to pay for managing residual risks should bear the lion's share of the costs, and those agents in greatest need for financial assistance should be allocated the bulk of the benefits, i.e. the resources globally available.

The IPCC has attributed trends in slow onset climate change processes and many climate extremes to anthropogenic greenhouse gas emissions (IPCC 2012). Moreover, climate model results evaluated in the latest IPCC report show peak windstorm velocity of tropical storms is set to increase, rainfall to become more volatile and sea levels to rise as ice caps melt, altogether leading to even more severe adverse impacts of climate change in the future (IPCC 2013). These findings imply an explicit and moral obligation for enhanced action on managing climate-related risks. Different principles of distributive justice, such as capacity to pay or greatest needs, may be applied to share the associated costs among agents, a principle which indeed the international community has built on as it supports the most vulnerable countries[1] (Posner and Weisbach 2010). In addition, climate change also brings along a need for considering issues of compensatory justice due to the unequal distribution of historical and current emissions as the root cause of global warming, the adverse distribution of impacts of climate change between the global North and the global South, and the fact that climate change is projected to lead to unavoidable and potentially irrecoverable losses and damages, such as of low-lying islands in the wake of strong sea-level rise (Roser et al. 2015).

Climate science has been making great progress in climate attribution research even with regard to specific events (see chapter by James et al. 2018). Recent research has shown a significant human element in mega events (Trenberth et al. 2015) such as superstorms Sandy in 2013 in the US, the Australian heatwave in 2013 (Herring et al. 2014), the 2016 drought in Kenia (WWA 2017). Mann et al. (2017) found that amplified arctic warming, influenced by climate change, makes temperature patterns (so called "planetary waves") that cause heatwaves, droughts and floods across Europe, North America and Asia more likely. Yet, causally linking anthropogenic emissions to extreme weather events and eventually to risks on people and property has not conclusively been achieved and will remain complex, as risks from climate-related events are shaped by many factors, including climate variability, rising exposure of people and assets as well as socio-economic vulnerability dynamics (Stone et al. 2013). While basic evidence to link anthropogenic GHG emissions to climate impacts is there (Schaller et al. 2016), making the concrete, enforceable case will remain much harder (Huggel et al. 2015; chapter by Bouwer 2018). Hence, and as argued above, the causal attribution and strict liability principle cannot be invoked currently (e.g. for legal action). Nevertheless, we suggest it is kept in the background, when decisions are made in the meanwhile based on principles of distributive justice. In the medium to longer-term, as evidence from climate change attribution studies potentially increases, we argue for a gradual integration of the compensatory justice dimension.

[1]Current international support for the most vulnerable countries is primarily based on implied responsibility and moral duty, as well as humanitarian reasons. Donor countries are currently not acting on explicit responsibilities.

To this effect, again, IPCC is the scientific authority with its methodological framework for detection and attribution. This systematic approach first focusses on detecting any trend in changes of key variables, then seeks to attribute those to climate change (e.g. change in local temperature and other system variables) (Cramer et al. 2014). As one example, Fig. 4.3 shows a summary application of the framework in terms of specifying the degree of confidence in the detection of observed impacts of climate change versus the degree of confidence in attribution to climate change drivers for tropical small islands. While, for example, it finds for “greater rates of sea level rise relative to global means” (a coastal system impact) both very high confidence levels of detection and attribution, it detects trends at very high confidence levels for tightly associated impacts in human systems (environmental degradation and casualties), albeit only at low levels of confidence, as risks in human systems are importantly shaped by socio-economic vulnerability and exposure.

4.2.3 Risk Evaluation: Considering Risk Preference and Risk Tolerance for Identifying Soft and Hard Adaptation Limits

Establishing risk as the overarching concept and metric naturally leads to addressing the question of risk coping or risk preference. While risk identification assesses risks in monetary and/or non-monetary terms, risk evaluation, involving socioeconomic analysis, leads to the notion of risk preference and risk tolerance. The process of risk evaluation examines agents’ (households, private and public sectors) ability to respond to risk, also termed risk tolerance. Economics has distinguished risk preference around risk aversion, neutrality and risk loving (Eeckhoudt et al. 2005). Risk analysis, e.g. Dow et al. (2013), building on Klinke and Renn (2002), conceptually break risk tolerance down into acceptable—no formal risk reduction interventions necessary; tolerable—risk reduction measures are necessary and implemented depending on resources available; and intolerable risks-risk cannot be taken on, i.e. action is required irrespective of costs but often no further action is possible, thus essentially defining risks that exceed the limits of adaptation (see Fig. 4.4).

Following such framing, one could argue that, backed up by considerable evidence (UNFCCC 2015b) as well as heuristics, the intolerable risk space (globally) with regard to ‘dangerous interference with the climate system,’ as put down in Article 2 of the UNFCCC, has been determined by the Paris agreement as starting beyond 1.5 °C of average global warming. The 1.5 °C line is a political compromise based on intense negotiations and normative discourse, which was informed by science. It is not a ‘hard’ system boundary and already today, with good levels of confidence, the IPCC has identified many communities and countries as facing substantial stress from climate change-exacerbated impacts on agriculture in Africa (high confidence), sea surge in small islands states (high confidence) and riverine flooding in Bangladesh (medium confidence) (IPCC 2014).

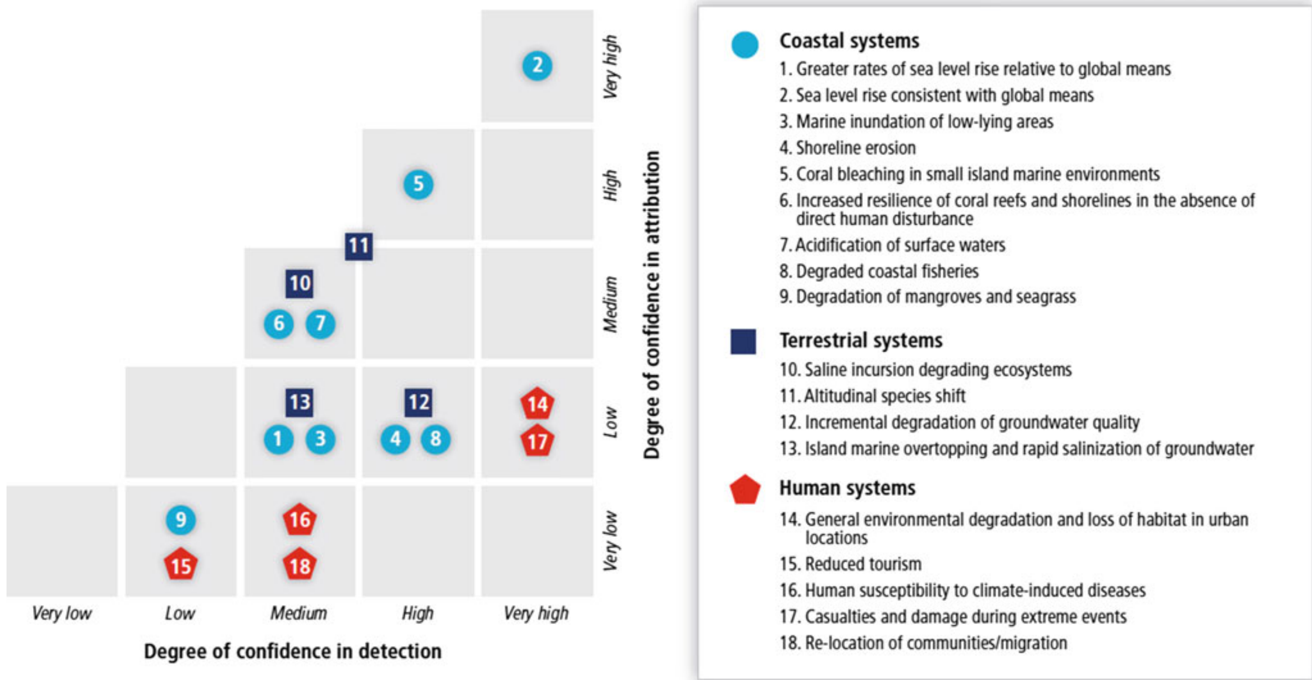

Fig. 4.3 Degree of confidence in the detection of observed impacts of climate change versus degree of confidence in attribution to climate change drivers for tropical small islands. *Source* Nurse et al. (2014, p. 1627)

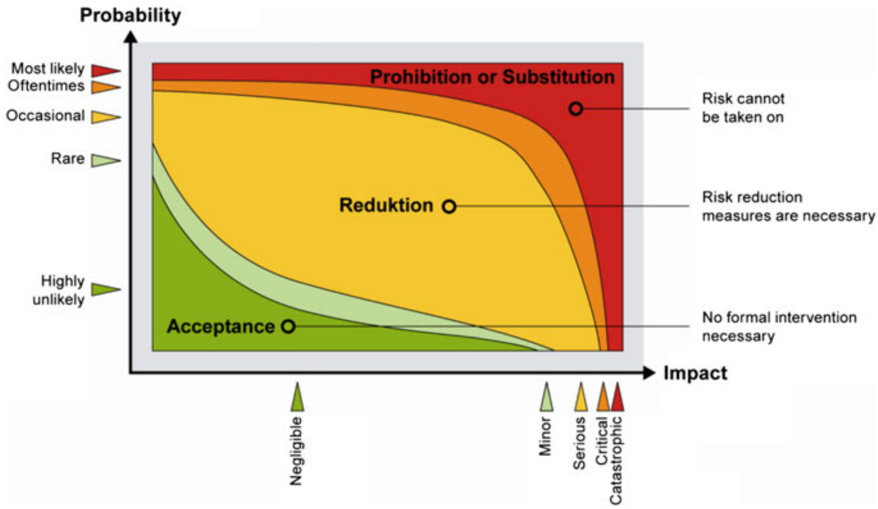

Fig. 4.4 Framing risk acceptance and (in)tolerance. *Source* Klinke and Renn (2002)

Eventually, what constitutes acceptable, tolerable, and intolerable risk can be defined in a subjective/normative or technical/science-based way. Risk tolerance is strongly determined by social, cultural, and economic factors and often requires subjective judgment (Dow et al. 2013). The IPCC Working Group II in 2014, for example, used expert judgement for determining levels of low, medium and high risk in its regional risk assessments. On the other hand, risk analysis has developed analytical procedures for segregating risk according to differential ability to bear risk to which risk policy instruments can be tailored to - termed risk layering (Mechler et al. 2014).

4.3 An Actionable Framework for Outlining the Risk and Policy Options Space for Loss and Damage

Overall, we argue for a practical and dynamic policy approach to the L&D debate based on the concept of comprehensive CRM and balancing the ethical principles of compensatory justice and distributive justice (see also Dellink et al. 2009, discussing a similar approach for the case of CCA). Figure 4.5 conceptualizes a dynamic needs and liability-based CRM approach to the L&D debate. It summarizes the two different notions of justice (compensatory and distributive) as linked to the different political principles (capacity and needs, liability and rights) on which policies tackling residual

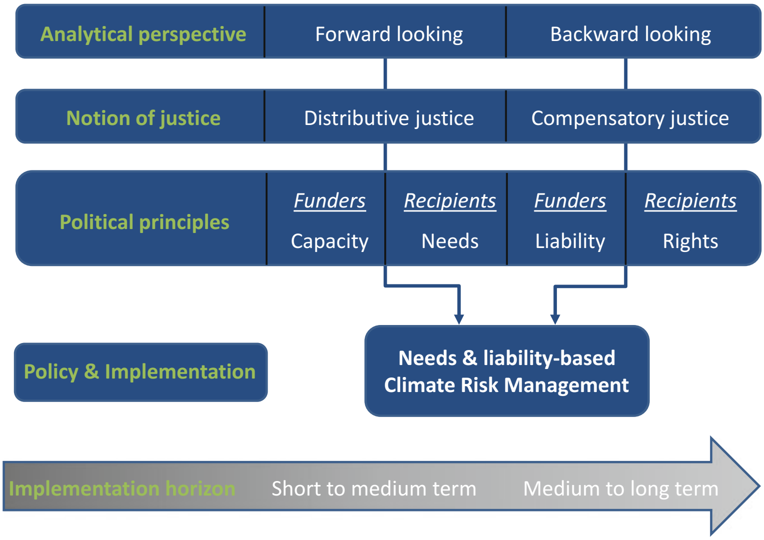

Fig. 4.5 Elements of the dynamic principled approach to Loss and Damage. *Source* Own Figure

risks in the domain of L&D are based. Given the present difficulties of attributing climate related losses and damages to (1) anthropogenic climate change and further (2) to certain agents, we propose taking on a distributive justice perspective for the short to medium-term. We argue for supporting comprehensive CRM based on the capacity to pay principle in those countries with the greatest need, identified, e.g. by a country level risk assessment based on risk layering (such as presented in Sect. 4.4), and focusing on both national and local levels.

Particularly in the medium to longer-term, as evidence from climate change attribution studies is bound to increase, we see a strong consideration of a compensatory justice dimension into the practical policy approach, by taking on (in addition) a liability-based perspective. This is important given the evidence on climate impacts and the fact that compensation will remain a central normative aspect in the climate negotiations and has to be dealt with in order to establish healthy long-term international relations, which themselves are a precondition for implementing just and effective responses to global climate change (Thompson and Otto 2015).

Naturally, the question emerges whether and how the three building blocks—risk identification, risk evaluation, and climate attribution and justice–which have been discussed in the previous section, can now be brought together and how to fill the principled approach outlined here with life to identify and visualise the Loss and Damage space? Our discussion builds on the policy proposal made by Mechler and

Schinko (2016) that considers key contributions from these fields of research and synthesizes respective insights into a visual representation of, what we consider, constitutes the risk and policy space for Loss and Damage.

4.3.1 The Loss and Damage Risk and Options Space

Synthesising existing literature, in particular building on IPCC assessments and the UNFCCC stocktake that led to defining the Paris ambition of 1.5 °C respectively 2 °C of change as the upper global warming limit (UNFCCC 2015b), the summary chart (Fig. 4.6) shows stylised past, present, and future climate-related risk levels and corresponding CRM portfolios for a given community or country (here again shown via the example of the Small Island States, whose risk profile has been presented in Fig. 4.2) facing severe climate risk today and expecting further increases in risk due to climate change (the socio-economic component is kept constant for ease of presentation, which does not affect our argumentation). In line with the three cornerstones presented above, the key foci are to (i) consider total climate-related risk incl. the adaptation deficit, (ii) include risk preference in terms of acceptable, tolerable and intolerable risk, (iii) consider risk of irreversible loss.

The options portfolio comprises actual and potential cumulative action in terms of CRM, implemented as part of separate or synergistic efforts related to DRR and climate adaptation. It is important to note here that while IPCC (2012) highlights the need to look at all drivers of risk and to synergistically manage those, in the context of climate anthropogenic climate change is at the centre of interest. The IPCC (2012) has suggested that "Effective climate risk management portfolios integrate sound risk analysis, risk reduction, risk financing, response and opportunities for learning." (see also chapter by Lopez et al. 2018; chapter by Botzen et al. 2018). How can those concepts be further operationalised at scale? As one example, Box 4.1 presents a comprehensive CRM framework developed for the case of informing Indian state and national-level policymakers, which may act as a blueprint for taking action on climate-related losses and damages.

Comprehensive risk management and policy can be broken down to comprise incremental (e.g., raising dikes), fundamental (e.g., floodplains instead of dikes) and transformative (e.g., voluntary migration from floodplains) interventions (see also Mechler and Schinko 2016). Accepting this stylised visualisation (Fig. 4.6), the options space for Loss and Damage may be determined as follows: (i) with climate change amplifying risk, there is a legitimate case for international action in the *Loss and Damage transformative risk space* to push risk down from intolerable to tolerable levels complementing the DRR and adaptation policy domains; (ii) the *Loss and*

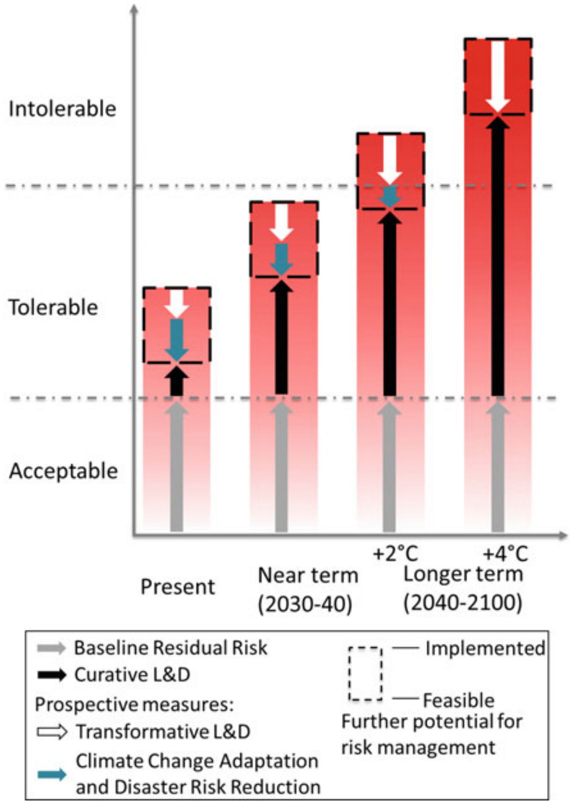

Fig. 4.6 Identifying the risk and policy options space for Loss and Damage. *Source* Own Figure based on Mechler and Schinko (2016)

Damage curative space opens up when technical and feasible risk reduction becomes limited over time with risk increasing, e.g. sea level rise leading to irreversible and unavoidable loss of land and induced migration, limiting the societally negotiated pathway, and foreclosing development opportunities (people being pushed to migrate from their homelands).

Box 4.1 A Climate Risk Management (CRM) framework for India

On behalf of the German Federal Ministry for Economic Cooperation and Development (BMZ), the German development assistance agency GIZ with partners developed a CRM framework that can be utilised to assess climate-related risks and identify management measures at various scales. In close cooperation with IIASA, KPMG and IIT Delhi, a six step process operationalising the CRM process at scale was developed (Fig. 4.7). The CRM process is embedded in a learning framework, which allows for updating decisions over time with mounting evidence and insights. Traditional DRR and CCA policy typically operates via incremental adjustments to existing management approaches. While such incremental learning is important in the short term, climate-related (residual) risks require a particular focus on locally-applicable bottom-up techniques for understanding risks and risk management interventions. Such techniques are, for example, Vulnerability Capacity Assessments (VCAs) and community-led focus groups. In the face of financial, technical and institutional constraints, fundamental and transformative learning is needed. These advanced learning loops aim at achieving the required adjustments of management processes at national and subnational levels in order to be able to deal with increasing risk over time.

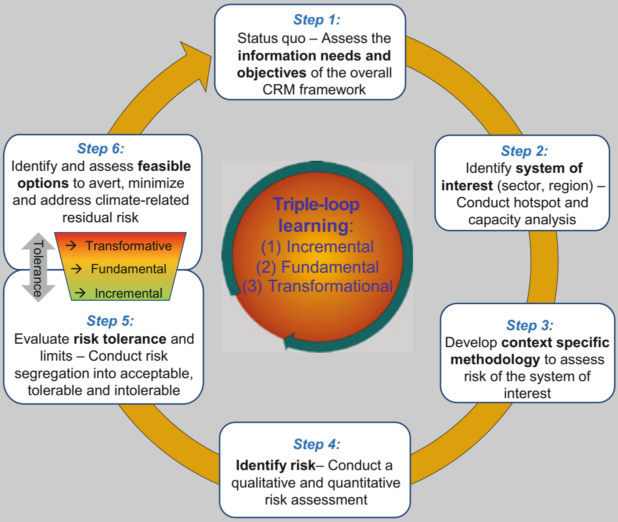

Fig. 4.7 Climate risk management (CRM) six step approach. *Source* GIZ et al. (2018 unpublished)

An exemplary application of the comprehensive framework to Tamil Nadu in India (cyclone and flood risk) served to test the methodological approach and glean its usefulness at state and local levels. The application showed that risks are on the rise due to climate and socio-economic drivers, and that risks are significantly affecting key objectives of households and the public sector. Furthermore, risk responses by farmers and households are largely of incremental, yet increasingly also of fundamental and importantly transformative nature. Governmental DRR and CCA institutions work well within their remit to provide incremental assistance, yet are usually not charged to deal with fundamental and transformative interventions. The assessment revealed that the risk management policy options space needs more attention and further deliberation with those at risk and in charge to deploy interventions with public support from state, national to international levels.

Transformative Measures

With sea level rise alone threatening to displace 72–187 million people by 2100 (Nicholls et al. 2011), transformative measures are increasingly needed, such as offering alternative livelihoods (e.g., switching from smallholder farming in coastal areas to services in cities) and assisting with voluntary migration, as compared with curative support for forced migration, which we discuss below (se also Mechler and Schinko 2016). Hino et al. (2017) find that managed retreat—"the strategic relocation of structures or abandonment of land"—is a potentially important transformational option when limits to structural protection or other adaptation measures to manage climate-related risks are reached. It is important to note that even though considered transformational, managed retreat is confronted by its own set of case-specific complexities and challenges, whether political, social, or legal (Hino et al. 2017).

Curative Measures

The space for curative measures is much less clear, and has not seen a lot of attention owing to the fact that it overlaps largely with demands for compensation, which have been ruled out from the Paris agreement, and because of existing limitations in the causal attribution of losses and damages from slow-onset processes and sudden-onset extreme events to anthropogenic climate change. The most advanced ideas in the context of curative measures have been articulated with regard to support for involuntary climate-induced displacement and forced migration. A climate displacement facility is being discussed under the WIM and proposals for approaches to deal with climate-induced displacement have been made, such as the Nansen Principles on Climate Change and Displacement (Nansen Conference 2011), and the Peninsula Principles on Climate Displacement Within States (Displacement Solutions 2015). Yet, concrete ideas for operationalisation are largely lacking.

For the contested discourse around international compensation for climate-related impacts exacerbated by climate change, only few concrete options have been put on the table so far. Sprinz and Bünau (2013), for example, find that no convincing mechanism has yet been found to compensate for climate-related impacts. The authors present a conceptual outline for a voluntary, internationally organized compensation fund and highlight the need for specialized, independent climate courts. At the national level, however, the establishment of national mechanisms to address climate induced losses and damages is being discussed, e.g. for Bangladesh. The chapter by Haque et al. (2018) suggests to make use of a reserve fund of approximately USD

140 million accumulated by unspent finance from the Bangladesh Climate Change Trust Fund in order to deal with those climate-related impacts not tackled by conventional DRR or CCA measures. This would also include ex-post compensation for losses and damages triggered by climate change induced slow onset events, salinity intrusion and increased intensity of cyclones.

4.4 Identifying the Space for Loss and Damage: An Application

Science can provide insights into defining the Loss and Damage risk space and associated policy response options. As indicated by the list of building blocks for a framework outlined above and also demonstrated by other chapters in this volume (see particularly chapters by Lopez et al. 2018; Botzen et al. 2018; Serdeczny 2018), science for L&D has to essentially be transdisciplinary and multifaceted. This requires input by, among others, climatology, meteorology, ethics and philosophy, geography, risk science and social sciences including economics. We proceed with an application building on transdisciplinary analysis and focused on one aspect, identifying fiscal risk tolerance with respect to managing climate-related extreme events.

4.4.1 From Risk Identification to Risk Evaluation: Risk Layering and Risk Tolerance

Climate risk assessments generally go through a structured process, starting with the identification of risks based on qualitative and quantitative methodologies. Risk identification is then followed by risk evaluation for determining risk tolerance, as the next step in the structured process, which, again, can build on various methods, such as eliciting stated risk preferences via focus groups, studying behaviour in markets to reveal preference, or use risk and economic modelling. Box 4.2 reports on the political decision-making process for defining acceptable and unacceptable risks for accident risks in Switzerland. Risk analytics has provided the scientific basis for the political decision in that case, but has tended to only matter up to a certain point. After all, the delimiters of acceptable to not acceptable risk areas have mostly been determined by the political process.

Box 4.2 Defining acceptable and unacceptable risks for accident risks in Switzerland

This example distinguishes different levels of accident risk acceptance as specified in the Swiss Industrial Accident Regulation, building on various inputs and procedures. The acceptable risk area demarcated in green and aggregating small risks (low extent of damage) is defined and regulated by specifications made in the Swiss Labour Act.

Beyond the transition zone (marked in yellow), risks are considered not acceptable (catastrophic, large-scale accidents) and identified in red. Here it is the (national-level) political decision-making process, building on analytics, but also other inputs, that determine risk areas as (non) acceptable, thus putting emphasis on rolling out a proper democratically-legitimated process for managing risks and appropriate risk management actions.

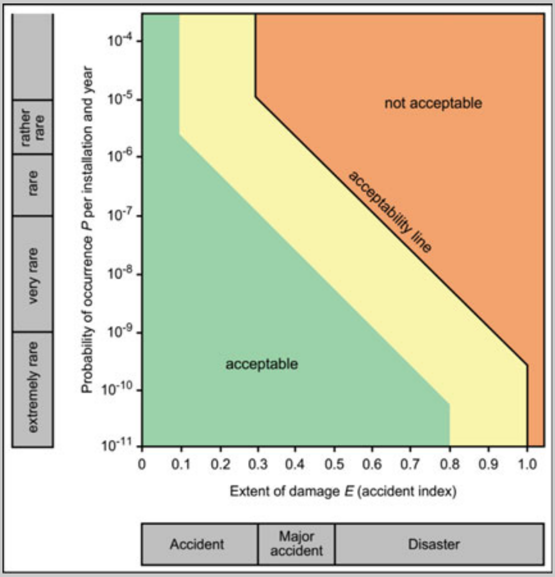

Fig. 4.8 Defining acceptable and unacceptable risks for accident risks in Switzerland. *Source* WBGU (1998)

As one promising analytical component of a CRM approach, the concept and practice of *risk layering* has seen increasing attention (Mechler et al. 2014; Mechler and Schinko 2016; Schinko and Mechler 2016). Risk layering involves segmenting risk into acceptable, tolerable and intolerable layers and allocating roles and responsibilities to reduce, finance or accept risks. We suggest to build on risk analytics in terms of a risk portfolio approach that breaks down total risk (as determined by probability and impacts/losses) into 4 distinct layers: (i) a layer for frequent risks for action on risk reduction, (ii) a medium layer of risks, where risk reduction will be combined with insurance and other risk-financing instruments that transfer residual risk; (iii)

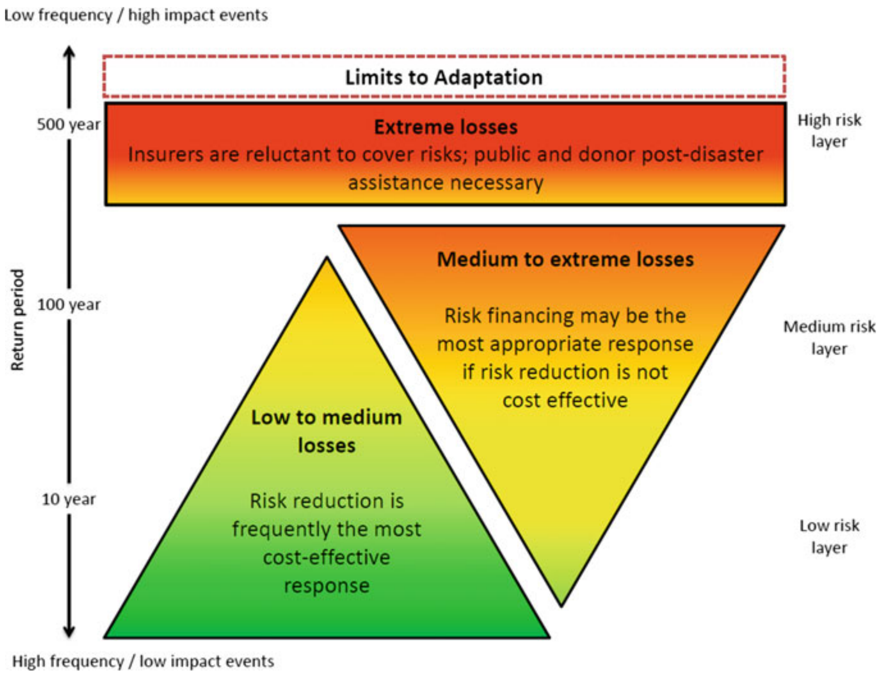

Fig. 4.9 Conceptualising risk layering. *Source* Based on Mechler et al. (2014)

a layer for infrequent catastrophic events, where public and international assistance is decisive, and (iv) a very rare, high risk layer, which will require assistance from international climate funding sources (see Fig. 4.9).

We argue that risk layering can be a valuable tool to define the Loss and Damage risk and options space for economic or market-based losses and damages, which can be quantified and costed. Employing a climate risk lens, a focus on loss distributions is appropriate as it provides information on the whole risk spectrum and not only on expected or average losses. Average annual (or expected) losses may differ greatly compared to potential losses of low probability events, e.g. for Bangladesh average losses associated with cyclone hazard are estimated to be around 0.5 billion USD, while a 500 year event is gauged to cause losses 40 times higher (UNISDR 2015). In addition, the risk layering approach can help determine the increase or decrease of climate-related risks, and disentangle the increase according to the underlying drivers of risk—hazard, exposure and vulnerability. This has important implications for the prioritisation of instruments within the options space.

As one example, Fig. 4.10 provides results from an application of the risk layering approach to the fiscal implications of flood risk in Bangladesh, the dominant climate-related risk in the country (based on Mechler et al. 2014; Mechler and Bouwer 2015; Hochrainer-Stigler et al. 2016) (for a more detailed discussion of the case of Bangladesh see the chapter by Haque et al. 2018). The quantitative risk assessment

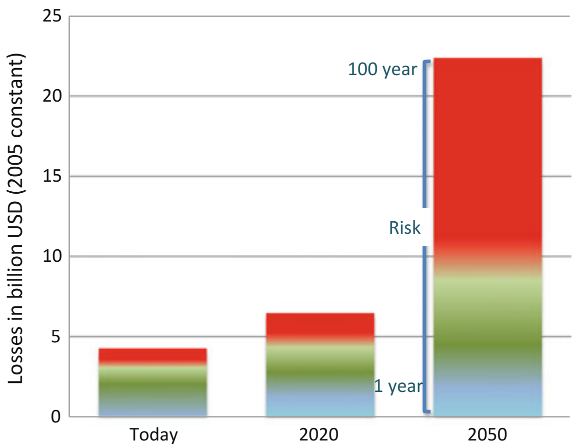

Fig. 4.10 Understanding risk and risk layering for the case of flood risk in Bangladesh. *Note* The different colours represent acceptable, tolerable and intolerable risk layers ranging from high probability, low impact events (1 year) to low probability, high impact events (100 years). *Source* Adapted from Mechler et al. (2014)

carried out with the IIASA CATSIM model (see Hochrainer-Stigler et al. 2014) builds on hydrological and socio-economic modelling and estimates increasing flood risk for 1 to 100 year events for present, 2020 to 2050 periods. A 100 year event today would cost about USD 4.7 billion, and increase in 2050 to more than USD 20 billion absent additional risk management measures. Much of the burden (infrastructure losses and support for households and business) generally may end up with the public sector and we find fiscal risk tolerance, determined by the country's capacity to absorb risk by national means and international assistance, is already today exceeded at events with a return period of less than 25 years (the area shaded in red). This fiscal risk threshold is expected to move down to even lower return periods over time and the costs are estimated to strongly increase, for which national (the planned compensation fund) and international funding will be required to pick up the burden. Risk layering thus not only helps to identify appropriate measures for tackling different layers of climate-related risk, but also provides an opportunity to investigate how risk layers will change in the future and what portions of risk may eventually become intolerable.

The logic of risk layering can be expanded to global analysis, which may be used to identify countries that are in need of international support for transformative and curative CRM measures. Figure 4.11 shows results from such an exercise identifying fiscal risk tolerance as the gap return period in financial resources available. Countries shaded in red face such instances of fiscal intolerance at particularly low return period events.

The fiscal risk evaluation methodology, while only covering certain aspects of the problem, enables analysts to determine global funding arrangements to support countries that face risks beyond their financial tolerance and may assist the international community in prioritising investment decisions with regard to transformative and curative CRM measures. Such a fund may build on available sovereign risk pooling arrangements in the Caribbean, Pacific, Africa and the Indian oceans (see chapters by Linnerooth-Bayer et al. 2018 and Schaefer et al. 2018).

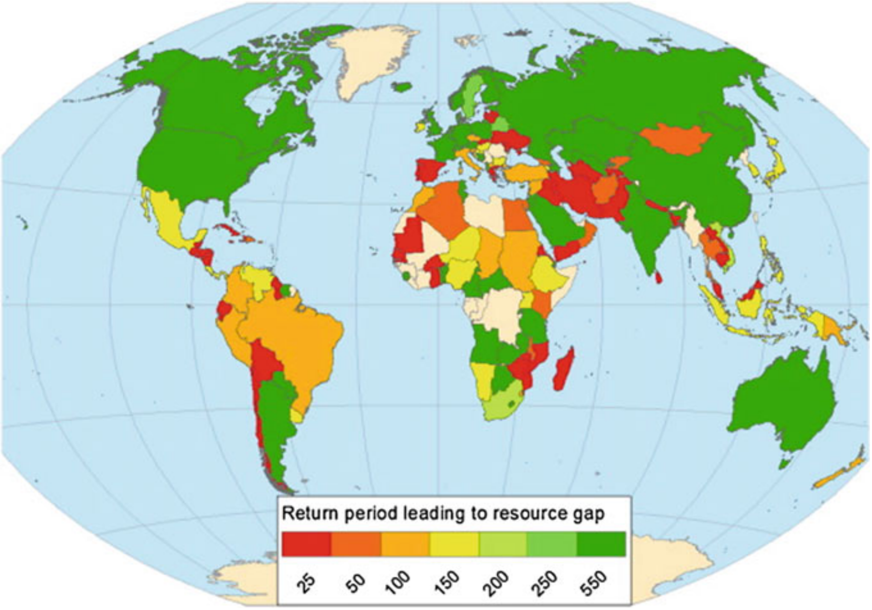

Fig. 4.11 Global map identifying high-level risks. *Note* The lower the return period the higher are the chances of a gap event. *Source* Based on Hochrainer-Stigler et al. (2014)

Overall, a risk-layering plus risk tolerance-based approach supports the integrated assessment of risk portfolios across global to country, down to local levels—a feature that is beneficial especially in the context of identifying the Loss and Damage risk space and corresponding implementation measures. As mentioned throughout, decision makers, communities or societies will differ in their understanding of what constitutes acceptable, tolerable and intolerable risk. Thus, risk layers will differ according to decisions at stake, context, and stakeholders involved.

4.5 Implications for Research and Policy

The L&D debate has been contested among those advocating compensation for *actual* losses and damages, versus those that have been suggesting support should be extended for tackling *potential* losses and damages, most prominently as part of further employing disaster risk management and climate insurance applications. Our discussion proposed an actionable way forward for the deliberations based on a broad interpretation and conceptualisation of comprehensive CRM, importantly aligning and balancing notions of distributive and compensatory justice. The suggested approach involves in a short-medium term, needs-based perspective, support for risk management actions, which fall beyond countries' ability to prevent and absorb risk; these actions to be supported internationally would largely comprise of fundamental and transformative risk management interventions. Particularly in a medium-longer term liability-based perspective, we emphasise consideration for liabilities attributable to climate change. As we suggest, these considerations can be integrated into a policy-oriented framework, which identifies the policy space for Loss and Damage as composed of curative and transformative measures.

Transformative measures exhibit substantial overlap with DRR and adaptation agendas, yet focus on high-level risks. This set of measures is seeing attention, mostly focussed on climate insurance (e.g. the G7 Initiative; GIZ 2015; Schäfer et al. 2018). Many analysts and advocates, however, see a need for broadening this debate towards comprehensive CRM, so that risk prevention and preparedness are better integrated and linked with risk financing. The curative action space is less clearly defined, while heavily contested. Beyond the calls for compensation for actual losses and damages, which are currently ruled out in the Paris agreement, the set-up of and support for a climate displacement facility has been in the spotlight and may qualify as an action item in this space.

Common to both sets of measures, and discussed as a working element of the agenda, is a need for committing finance for the genuine implementation of the WIM. Such commitments to finance may have a prospective and transformative function in terms of financial support for CRM, encompassing financing for climate insurance premium subsidies, reserve capital and technical assistance. The curative function involves finance for dealing ex-post with unavoided and unavoidable loss and damage, on top of mechanisms that deal with avoidable risk. An important aspect to emphasise is that our proposed principled approach, ideally to be linked to international commitments to support, can serve as a sort of "canary in the coal mine" where risks, costs and implications detected now and modelled for later time horizons at local to regional risk management scales can help to inform the ultimate remit of the UNFCCC, which is to harness collective global action for "avoiding dangerous interference with the climate system" (United Nations 1992).

There is analytical and modelling expertise that can be employed to identify risks 'beyond adaptation' and to define the Loss and Damage risk and options space. We argued that risk layering can be a valuable tool—at least for market-based losses and damages. Non-economic or non-market based impacts may require alternative assessment tools. When taking a climate risk lens, probabilistic loss distributions are useful to provide information about the whole risk spectrum beyond expected or average losses only. The risk layering approach can also provide support for determining any increase (or decrease) of climate-related risks, and disentangle the contributing drivers of risk—hazard, exposure and vulnerability, which has important consequences for the prioritisation of instruments within the options space. It is important to note, however, that disentangling anthropogenic and natural drivers of risk is still not conclusively possible.

Our application of a risk analytical approach, comprising risk layering and risk-based probabilistic modelling to the case of flood risk in Bangladesh and at the global level represents a methodological approach for determining countries' financial needs for dealing with intolerable risk layers. Notwithstanding the fact that our example dealt with monetary losses, we hold that, with many aspects of being of immaterial nature, our broad risk and justice approach, with a different set of methods and tools, is also applicable to issues such as migration and preservation of cultural heritage. Such and other assessments at national as well as at regional and global scales may provide the basis for tackling the salient follow-up question towards the genuine implementation of the WIM around justice aspects: who will provide (receive) which share of the required levels of financial support, and based on which burden-sharing principle? After all, if any of the options discussed here and as part of the WIM process are to see acceptance and implementation, they need strong embedding in a framework based on principles of justice.

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