Climate risk management – a framework

Promising pathways to avert, minimise, and address losses and damages

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On behalf of
German Federal Ministry for Economic Cooperation and Development (BMZ)

As at:
Bonn, November 2021

Concept paper

Climate risk management – a framework

Promising pathways to avert, minimise, and address losses and damages

Composed by the Global Programme on Risk Assessment and Management for Adaptation to Climate Change (Loss and Damage) (GP L&D) as of 31.10.2021

The purpose of this paper is to serve as an informational document that captures the GP L&D's understanding and state of the art regarding the topic of Climate Risk Management (in this document referred to as CRM) in the context of the global programme's work. This concept paper is a supplement to the much shorter infosheet with the same title and provides in-depth information on the GP L&D's understanding and operationalisation of CRM. The document is to inform GIZ colleagues so as to support the knowledge management and sustainability of the programme. It shall be used as a basis for common understanding, discussion, and further development of the CRM concepts, guidelines, and instruments developed by the GP L&D – in particular the CRM framework.

Contents

Abbreviations

AR4	Fourth Assessment Report (IPCC)
AR5	Fifth Assessment Report (IPCC)
AR6	Sixth Assessment Report (IPCC)
BMZ	German Federal Ministry for Economic Cooperation and Development
CCA	Climate Change Adaptation
COP	Conference of the Parties
CRA	Climate Risk Assessment
CRM	Climate Risk Management
DRR	Disaster Risk Reduction
EWE	Extreme Weather Event
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
GP L&D	Global Programme on Risk Assessment and Management for Adaptation to Climate Change (Loss and Damage)
IPCC	Intergovernmental Panel on Climate Change
L&D	Loss and Damage
NAP	National Adaptation Plan
NDC	Nationally Determined Contribution
NELD	Non-Economic Losses and Damages
SDG	Sustainable Development Goal
SOP	Slow Onset Process
SOE	Slow Onset Event
SR1.5	Special Report on Global Warming of 1.5° C (IPCC)
UNDRR	United Nations Office for Disaster Risk Reduction
UNFCCC	United Nations Framework Convention on Climate Change
WIM	Warsaw International Mechanism for Loss and Damage Associated with Climate Change Impacts
SIDS	Small Island Developing States
SOP	Slow-Onset Process (synonym to SOE and used in this publication)
SOE	Slow-Onset Event
SRCCL	Special Report on Climate Change and Land (IPCC)
SROCC	Special Report on the Ocean and Cryosphere in a Changing Climate (IPCC)
SSP 1 – 1.9	Shared Socioeconomic Pathway 1 – 1.9 (IPCC very low emissions scenario)
SSP 5 – 8.5	Shared Socioeconomic Pathway 5 – 8.5 (IPCC very high emissions scenario)
TEG-SOE	Technical Expert Group on Slow Onset Events
UNDRR	United Nations Office for Disaster Risk Reduction
UNFCCC	United Nations Framework Convention on Climate Change
WIM	Warsaw International Mechanism for Loss and Damage associated with climate change impacts

1. Introduction

The increasingly severe impacts of anthropogenic climate change are undermining progress on the 2030 Agenda for Sustainable Development. Extreme weather events (EWE) such as cyclones, heatwaves, and floods are becoming more intense and frequent. Simultaneously, climate change manifests in accelerating slow onset processes (SOP)[1] like sea-level rise, desertification, and glacial retreat that are transforming our very living conditions but have received less attention in the realm of climate policy. Both EWE and SOP substantially impact livelihoods, ecosystems, and economic performance, and will have even more serious impacts in the future. They jeopardise achievement of the Sustainable Development Goals (SDGs) and hinder the enjoyment of human rights, particularly for poor and vulnerable people in developing countries. Adverse impacts on public health, manifested for example in excess mortality during heatwaves, and on ecosystems, seen in the loss of biodiversity, are of particular concern and require urgent attention. In addition, the impacts of climate change influence decision-making in private sector investments, ranging from the large-scale value chains of large enterprises to micro-, small and medium-sized enterprises in developing countries. They also influence the governance of settlements, from small villages to megacities.

The latest findings of the Intergovernmental Panel on Climate Change (IPCC), in particular those contained in its 6th Assessment Report (AR6) and Special Reports on Global Warming of 1.5° C (SR1.5), on Climate Change and Land, and on the Ocean and Cryosphere in a Changing Climate, underline the need to urgently act. The reports confirm that climate change has contributed to changes in many land and ocean ecosystems as well as to impacts on natural and human systems. The SR1.5 shows that impacts at 2° C of warming are likely to be much more serious than previously anticipated, and that keeping global warming to 1.5° C could potentially spare hundreds of millions of people from slipping (back) into poverty. On the other hand, the IPCC Special Report on Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation shows that vulnerability and exposure, as key determinants of risk, have a considerable influence on the (potential) impacts of climate-related EWE and SOP. Therefore, successful adaptation must consider these factors as important parts of the equation.

Irrespective of ongoing climate policy efforts, residual risk from climate change impacts remains in all countries for all plausible scenarios and could result in losses and damages. German development cooperation (DC) addresses climate risk through Climate Risk Management (CRM). Among other initiatives, the German Federal Ministry for Economic Cooperation and Development (BMZ) has commissioned the GIZ Global Programme on Risk Assessment and Management for Adaptation to Climate Change (Loss and Damage) (GP L&D). The programme generates tried and tested guidelines, innovative concepts and practical instruments for climate risk assessment and management for application by German DC in regions that are particularly vulnerable to climate change. The GP L&D's main function is to generate experience that a) can be utilised in German DC to help partner countries better manage losses and damages; and b) simultaneously provides the international climate policy dialogue with recommendations for action. In addition, the programme supports the BMZ in shaping the German position under the United Nations Framework Convention on Climate Change (UNFCCC), particularly with respect to the Warsaw International Mechanism for Loss and Damage Associated with Climate Change Impacts (WIM). Moreover, the programme activities are aligned with the United Nations Office for Disaster Risk Reduction (UNDRR), thereby capitalising on existing tools and experience from the disaster risk management community.

This concept paper serves as an informational document that captures the GP L&D's understanding and state of the art regarding the topic of CRM in the context of its work. It is a supplement to the much shorter infosheet with the same title and provides in-depth information on the GP L&D's understanding and operationalisation of CRM. It is also a technical and conceptual supplement to the programme's general overview document *("Gesamtschau")* which contains a much more detailed description of concrete activities completed during the eight-year duration of the programme (in German). The document's main purpose is to inform GIZ colleagues so as to support the knowledge management and sustainability of the GP L&D. It shall be used as a basis for common understanding, discussion, and further development of the CRM concepts, guidelines, and instruments developed by the GP L&D – in particular the CRM framework.

1 Alternative terminologies exist to describe ongoing climate-induced changes of natural systems. The IPCC and UNFCCC refer to "slow onset events"; however, the term "event" might be misleading as these changes do not necessarily have a clear time frame. Hence, throughout this publication the term "slow onset processes" is used.

2. Loss and Damage: A political term

Impacts from climate change are reflected in international policy agendas as part of the Paris Agreement, the 2030 Agenda for Sustainable Development and the Sendai Framework for Disaster Risk Reduction 2015–2030. These international policy frameworks provide guidance for the BMZ's and GIZ's objectives in the implementation of their DC efforts on CRM. This is framed within Germany's policy position on climate change *(BMZ, 2017)*, and specifically climate change adaptation *(BMZ, 2017)* and the management of disaster and climate risks *(BMZ, 2019)*. Through its efforts, German DC supports its partner countries in averting, minimising, and addressing losses and damages associated with climate change impacts.

Under the UNFCCC, the topic of Loss and Damage (L&D) has gained in importance and led to the establishment of the WIM in 2013. The aim of the WIM is to "address loss and damage associated with impacts of climate change, including extreme events and slow onset events in developing countries that are particularly vulnerable to the adverse effects of climate change" *(UNFCCC, 2013)*. In 2015, the Paris Agreement emphasised the topic's relevance by introducing a standalone article (Article 8) on averting, minimising, and addressing loss and damage. In 2019, the WIM established the Santiago Network to catalyse technical assistance, as well as three new thematic expert groups, which now reflect all workstreams under the WIM's workplan.

International policy frameworks on climate change converge with those on sustainable development. The Paris Agreement makes explicit reference to the 2030 Agenda for Sustainable Development, recognising the close links between the two. In 2015, the international community adopted the 2030 Agenda and defined the 17 SDGs. While acknowledging that the UNFCCC is the primary international, intergovernmental forum for negotiating the global response to climate change, the SDGs include a dedicated goal on climate action (SDG 13) and associated targets and indicators. These include the target to strengthen resilience and adaptive capacity to climate-related hazards and natural disasters in all countries (13.1) and indicators, among others, on the number of countries with national and local disaster risk reduction strategies (13.1.2).

International disaster risk reduction policy acknowledges climate change as a risk driver. Adopted in March 2015 at the Third United Nations World Conference on Disaster Risk Reduction, the Sendai Framework builds on the International Strategy for Disaster Reduction agreed in 2000 and the subsequent Hyogo Framework for Action 2005–2015. Implemented by UNDRR, the Sendai Framework is a voluntary, non-binding agreement, consisting of seven targets and four priorities for action. The Sendai Framework highlights the growing risks from climate change, underlines the strong linkages between natural disasters and climate-related extreme events, and reflects a major shift from the traditional emphasis on disaster response to disaster risk reduction.

The political history of Loss and Damage

The origins of the political debate around L&D lie in calls from the Small Island Developing States for better consideration of climate-related Loss and Damage in the realm of climate policy. In 1991, the Alliance of Small Island States (AOSIS) proposed an international insurance pool to compensate low-lying islands for losses and damages, especially those associated with sea-level rise. Primarily due to discussions around compensation, negotiations around L&D have often been described as highly political, contentious and polarised between developed and developing countries *(Boyd et. al, 2017)*. However, according to research including interviews with 38 key stakeholders in research, practice, and policy, there is no evidence for "a simple polarization between political actors from developed and developing countries, or those who seek compensation and those who wish to avoid paying compensation", and "points of agreement and overlaps between stakeholder groups" do exist *(Boyd et al., 2017)*. The same study identifies a spectrum of four L&D perspectives: (1) the Adaptation and Mitigation perspective according to which "the UNFCCC already has mechanisms for adaptation and mitigation, and [...] these existing efforts are sufficient to prevent L&D"; (2) the Risk Management perspective for which "discussions around L&D represent an opportunity to work towards comprehensive risk management by building on existing efforts under DRR, climate change adaptation, and humanitarian work"; (3) the Limits to Adaptation perspective which "is centred around the limits to adaptation, and residual L&D beyond mitigation and adaptation [where the] focus is on vulnerability, and on the most vulnerable

who are already perceived to be suffering L&D"; and (4) the Existential perspective with an "emphasis on irreversible loss, non-economic losses (NELD), justice and responsibility" *(Boyd et. al, 2017)*.

Despite these differing views, agreements and compromises between Parties have led to L&D becoming a formal part of the UNFCCC. During the 18th Conference of Parties (COP18) in 2012 in Doha, the COP officially invited all Parties to install an L&D mechanism. In line with this development, the WIM was established at COP19 in Warsaw and endowed with the responsibility to avert, minimise and address L&D. The Executive Committee of the WIM is the body leading the implementation of the Mechanism, under the guidance of the COP, to which it reports annually. According to Article 8 of the Paris Agreement, all "Parties recognize the importance of averting, minimizing and addressing loss and damage associated with the adverse effects of climate change, including extreme weather events and slow onset events, and the role of sustainable development in reducing the risk of loss and damage". Parties agreed to enhance understanding, action, and support with respect to loss and damage, among others through comprehensive (climate) risk assessment and management, early warning systems, and risk insurance facilities.

Defining Loss and Damage

The formalisation of L&D within the UNFCCC process has not led to a universally accepted definition of the term. There are various definitions used by different actors and authors. When moving from negotiations to implementation, it is helpful to keep in mind that these definitions reflect the differing L&D perspectives and priorities as described above, but that existing points of agreement and overlaps open up room for compromise and collaboration. The GP L&D follows the UNFCCC's definition of L&D in its work.

For the UNFCCC, 'loss' refers to negative impacts for which reparation or restoration is impossible, as distinct from 'damage', which refers to negative impacts for which reparation or restoration is possible *(UNFCCC, 2012)*. The UNFCCC working definition of L&D is:

> "The actual and/or potential manifestation of **impacts** associated with current climate and future climate change that negatively affect human and natural systems" (UNFCCC, 2013).

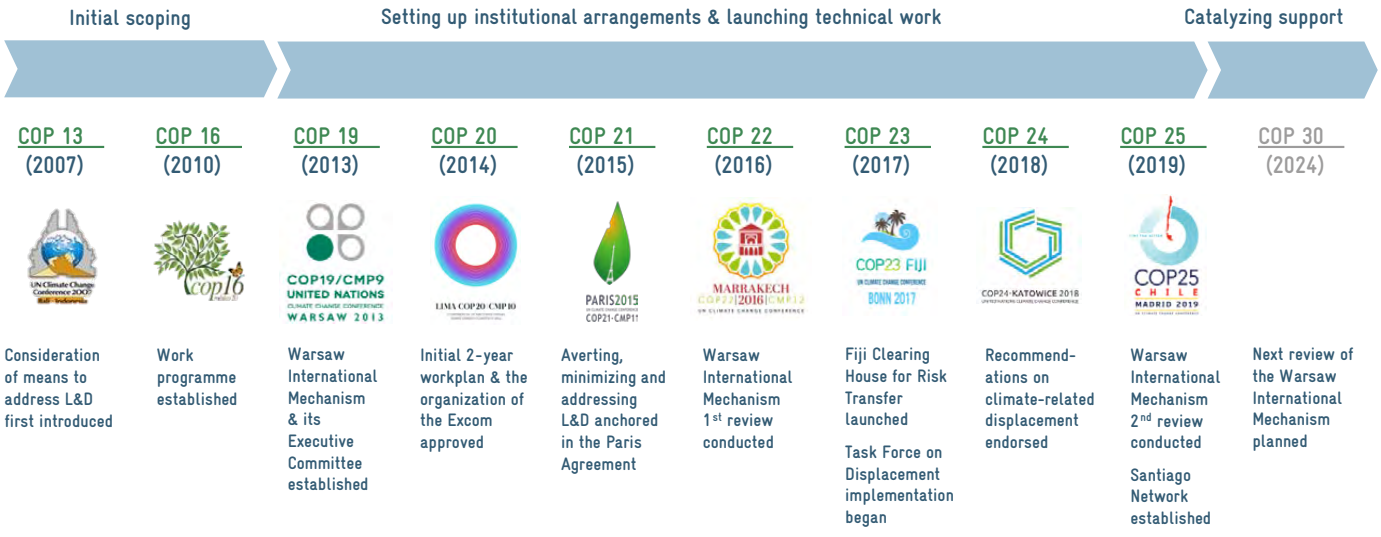


Figure 1: Milestones of Loss and Damage within the UNFCCC (UNFCCC 2021)

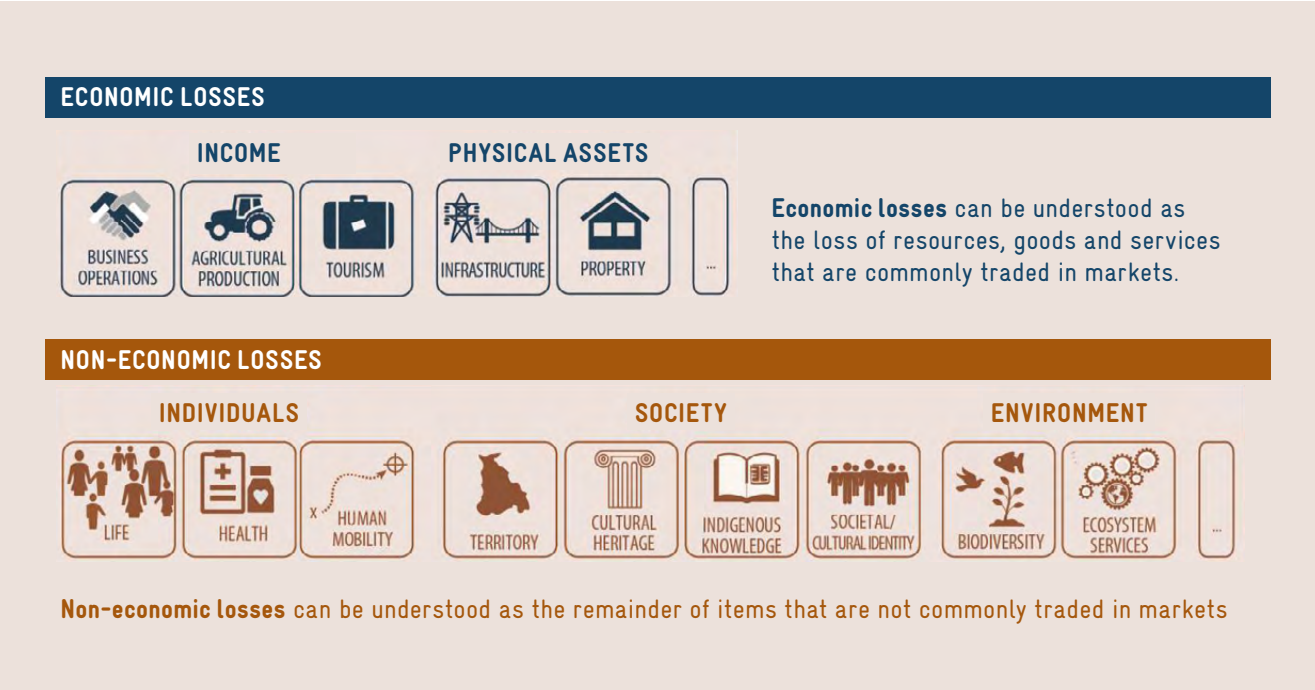


Figure 2: Overview of economic and non-economic losses (UNFCCC 2021)

The IPCC SR1.5 suggests distinguishing between "Loss and Damage"[2] and "losses and damages" as follows:

> "Research has taken **Loss and Damage** (capitalized letters) to refer to political debate under the UNFCCC following the establishment of the Warsaw Mechanism on Loss and Damage in 2013 [...]. Lowercase letters (losses and damages) have been taken to refer broadly to harm from (observed) impacts and (projected) risks (see Mechler et al., in press)" (IPCC, 2018).

The definition proposed by the UNFCCC encompasses both economic and non-economic losses and damages. Indeed, the topic of non-economic Loss and Damage (NELD) is gaining increased attention in negotiations under the UNFCCC *(Serdeczny et al., 2016)*. Focusing on the negative impacts of climate change that are difficult to quantify or measure in monetary terms *(Serdeczny et al., 2016; Serdeczny et al., 2018)*, NELD are understood by the UNFCCC as losses "that are not commonly traded in markets" *(UNFCCC, 2013b)*. However, losses and damages discussed in the AR5 are primarily economic in nature, including damage to property and infrastructure and income loss. The Working Group II contribution to the AR6 is expected to elaborate more on the concept of (non-economic) losses and damages. Types of NELD such as loss of biodiversity, identity, livelihoods, and health have received significantly less attention than economic losses and damages. The lack of a clear differentiation and common terminology, and the fact that it is difficult to quantify them, make it difficult to draw attention to NELD. They can be either material or non-material, and either have value in themselves (intrinsic value, e.g. health) or constitute a way to achieve a valuable item (instrumental value, e.g. food to maintain health) *(Frankhauser and Dietz, 2014)*. Due to the absence of a common economic value for biodiversity, social-cultural capital, mental health, and even human life, it is difficult to measure NELD, regardless of their importance (Serdeczny et al., 2016). In developing countries, NELD may be even more significant than economic losses *(UNFCCC, 2013)*.

2 The abbreviation L&D in this paper refers specifically to Loss and Damage (capitalized).

The workplan of the Warsaw International Mechanism for Loss and Damage

The WIM promotes the implementation of approaches to address losses and damages associated with the adverse effects of climate change in a comprehensive, integrated, and coherent manner by undertaking, inter alia, the following functions:

1. Enhancing knowledge and understanding of comprehensive risk management approaches.
2. Strengthening dialogue coordination, coherence, and synergies among relevant stakeholders.
3. Enhancing action and support, including finance, technology, and capacity building.

An initial two-year workplan presenting nine action areas was approved at COP20 in 2014. Building on this workplan, an indicative framework for a five-year rolling workplan was agreed in 2016 (COP22). This workplan has been operational since 2018 and is divided into five thematic work streams: slow onset events; non-economic losses; comprehensive risk management approaches; migration, displacement, and human mobility; and action and support.

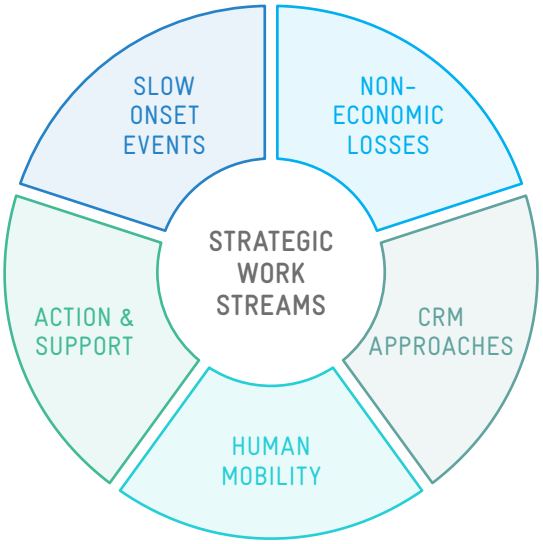


Figure 3: WIM strategic workstreams (UNFCCC, 2021)

The WIM Executive Committee has established five expert groups following the division of work of the different work streams. In chronological order, these are the Task Force on Displacement, Technical Expert Group on Comprehensive Risk Management, Expert group on Slow Onset Events, Expert Group on Non-Economic Losses, and Action and Support Expert Group.

Developing countries called for the strengthening of the role of the WIM and its Executive Committee during the second review of the mechanism at COP25 in 2019. As a result, COP25 decided to establish the Santiago Network to catalyse technical assistance for averting, minimising, and addressing losses and damages.

3. Concepts of risk

The evolution of risk conceptualisations

GIZ's GP L&D refers throughout its projects and publications to the risk understanding elaborated in more detail in IPCC reports. In the AR4 *(IPCC, 2007)*, a risk understanding was presented which was based on a wide understanding of the term vulnerability. This conceptualisation is widespread in the scientific community as well as the community that uses and applies scientific information under the paradigm of climate change adaptation (CCA). However, since the IPCC Special Report on Extreme Events and Disasters *(IPCC, 2012)* and following the AR5 *(IPCC, 2014)*, a major shift in the risk conceptualisation was established (see Figure 4). The major differences and new aspects in the AR5 concept compared to the AR4 are:

1. the combination of hazard, vulnerability, and exposure defines risk;
2. hazard not only refers to the climate signal, but also climate-related direct physical impacts of EWE and SOP;
3. the concept of exposure is introduced as an explicit expression of the presence and relevance of exposed elements; and
4. likelihood or uncertainty is explicitly addressed, which can be better covered with a risk-based approach.

The risk concept in these latter reports is more closely aligned with the risk understanding of the community working under the paradigm of disaster risk reduction (DRR). While the focus of the IPCC and the GP L&D is on risk in the context of climate change, related to both EWE and SOP, the DRR community also considers other types of risks, such as risks resulting from biological and geophysical hazards (e.g. volcanic eruptions and earthquakes). In reality, however, climate and non-climate hazards and impacts often strongly interact. Therefore, the new alignment not only aims to identify and evaluate the risk of impacts from climate change as comprehensively as possible, it also strives for the exploitation of synergies and joining of forces between the different fields. The AR5 conceptualisation of risk emphasises the interrelations between climate change mitigation (reducing or preventing emissions of greenhouse gases into the atmosphere), adaptation (adjusting to actual or expected climate change and its effects), DRR (reducing the damage caused by natural hazards like earthquakes, floods, droughts, and cyclones through an ethic of prevention) and sustainable development. The adoption of the Paris Agreement, Sendai Framework, and 2030 Agenda in the following year also confirmed the interrelations between mitigation, adaptation, DRR, and sustainable development.

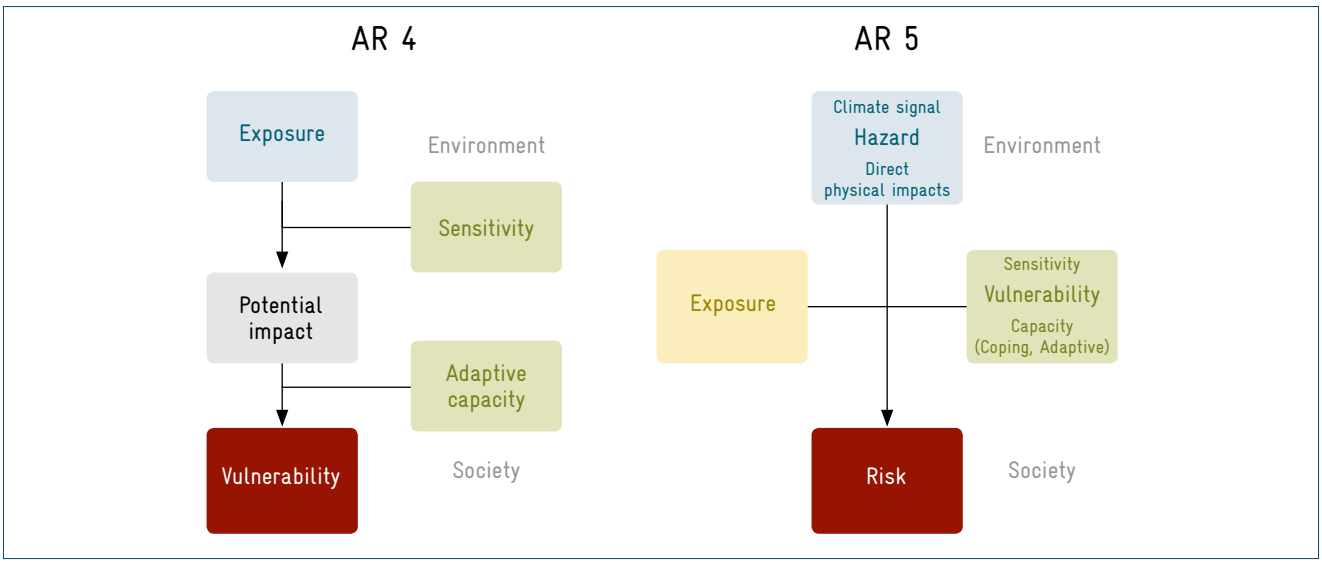


Figure 4: Comparison of the components of climate change vulnerability (AR4) and climate risk (AR5) (GIZ and Eurac, 2017)

Key terms

IPCC reports since the AR5, especially Special Reports such as the SR1.5 *(IPCC, 2018)* and Special Report on the Ocean and Cryosphere *(IPCC, 2019)*, followed the conceptualisation of risk published in the AR5 very closely and made only minor modifications to the definitions of key terms. Therefore, the GP L&D draws mainly on the risk concept of the AR5, considering recent conceptual developments in IPCC reports.[3] In the context of climate risks, literature focuses on two types of phenomena:

Extreme weather events (e.g. cyclones, extreme rainfall, storm surges, flooding, heatwaves, droughts) are rare shifts of weather or climate variables above or below certain thresholds *(IPCC, 2012, 2019; UNFCCC, 2012)*. The SR1.5 defines EWE as follows:

> "An **extreme weather event** is an event that is rare at a particular place and time of year. Definitions of rare vary, but an extreme weather event would normally be as rare as or rarer than the 10th or 90th percentile of a probability density function estimated from observations. By definition, the characteristics of what is called extreme weather may vary from place to place in an absolute sense. When a pattern of extreme weather persists for some time, such as a season, it may be classed as an extreme climate event, especially if it yields an average or total that is itself extreme (e.g., drought or heavy rainfall over a season). See also Heatwave and Climate extreme (extreme weather or climate event)" (IPCC, 2018).

Slow onset processes (e.g. sea-level rise, ocean acidification, glacial retreat, rising temperatures), on the other hand, include hydrometeorological, geophysical, climatic, ecological, and environmental processes that unfold gradually over longer time periods, for instance decades or centuries, and occur at different spatial extents up to and including the global, while the magnitude of change can accelerate over time, potentially triggered and magnified by climate change (own definition drawing on various sources *(see GIZ and IIASA, 2021)*.

While EWE can have dramatic impacts in a relatively short amount of time (in some cases only a couple of hours), SOP can lead to long-term changes in natural systems, and carry the risk of exceeding irreversible tipping points. For example, the weakening or eventual shutdown of the Atlantic Meridional Overturning Circulation (AMOC) would have impacts such as reduced agricultural productivity and loss of arable land around the North Atlantic, but also globally, and a dieback in the northern European and Asian boreal forests. It could also lead to a disruption of the African monsoon and affect the stability of the Amazon rainforest in the long term *(OECD, 2021)*.

Both EWE and SOP, especially when amplified by released greenhouse gases that contribute to global warming and a changing climate, bear the potential to trigger losses and damages. Depending on the **exposure and vulnerability**, the impacts and losses and damages vary in severity and type. As shown in Figure 5, risk is not only determined by hazards, but also by the interaction of environmental and socio-economic factors. The IPCC *(2019)* defines risk as "the potential for adverse consequences for human or ecological systems, recognising the diversity of values and objectives associated with such systems".

Risk is determined not only by hazards (EWE and SOP) but also by exposure and vulnerability to these hazards. Therefore, the second factor of risk after hazards is vulnerability. **Vulnerability** is "the propensity or predisposition to be adversely affected" *(IPCC, 2019)*. Vulnerability encompasses thereby the capacity to cope and adapt as well as sensitivity or susceptibility.

Those two elements make clear that in the GP L&D's understanding of the term, vulnerability always has an active and a passive component. The capacity to cope and adapt is either short-term or long-term anticipatory action or reaction to hazards, and addresses the agency of an actor *(IPCC, 2018)*. Sensitivity or susceptibility is the more passive physical predisposition to be affected by a dangerous phenomenon and to suffer harm as a consequence of intrinsic and contextual conditions *(IPCC, 2012)*.

The third factor of risk is **exposure**, which describes the "presence of people; livelihoods; species or ecosystems; environmental functions, services, and resources; infrastructure, or economic, social, or cultural assets in places and settings that could be adversely affected" *(IPCC, 2019)*.

3 At the time of publication of this concept paper, only the Working Group I Report on the physical science basis of AR 6 had been published.

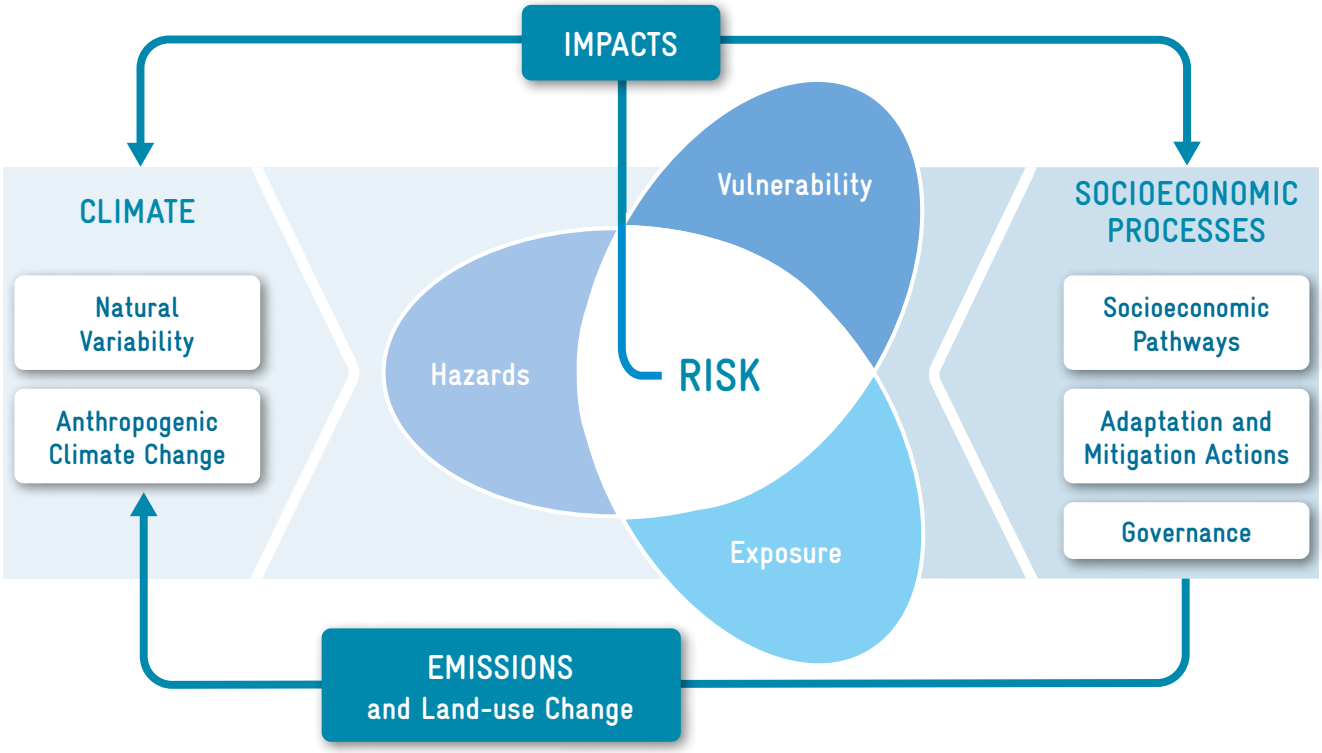


Figure 5: Illustration of the core concepts of the IPCC AR5 (IPCC, 2014)

The combination of hazard, exposure, and vulnerability creates risk, which can manifest as impacts. Impacts generally refer to adverse or beneficial effects of realised risk on lives; livelihoods; health and well-being; ecosystems and species; economic, social, and cultural assets; and services *(IPCC, 2019)*. The underlying interlinkages of this cause–effect relationship between hazard, exposure, and vulnerability can be described through impact chains. Impact chains help to derive interdependencies of all risk components (hazard, vulnerability, and exposure) and to demonstrate how biophysical and socio-economic factors interact. They also include cultural and ecological factors that are important for non-economic evaluation. An impact chain can, for example, show how a tropical cyclone in a coastal area leads to storm surges, which increase salinisation of land in coastal zones through saltwater intrusion. Together with exposure factors such as a high density of farmers in low-lying coastal areas and vulnerability factors such as poor irrigation practices and a weak institutional framework for water management, this can lead to the risk of reduced crop yields for famers *(see GIZ, 2021b)*.

Moreover, **cascading impacts** become visible using impact chains. Cascading risks are risks "that develop due to a hazard and its impacts in situ to the systems affected, flowing out to other domains" *(Lawrence et al., 2020, 2)*. Translated into practice, a secondary event in a natural or human system generated through a hazard could be a drought, which could cause ground movement (settling and cracking) affecting the integrity of pipe systems responsible for supplying water – this is referred to as a cascading impact *(Lawrence et al., 2020, 7)*. Usually, a resulting impact following cascading effects is significantly larger than the initial impact *(IPCC, 2019)*.

Cascading disasters occur when cascading effects accumulate over time, resulting in unexpected secondary events of greater impact *(Adger et al., 2018)*. Empirical examples of cascading impacts often focus on critical infrastructure and lifelines. Shimizu and Clark *(2015)*, for example, discuss the difficulties of risk management to hurricanes and earthquakes at a governance/institutional level that focus on interconnected issues, such as public policies, infrastructure, economies, production, and supply chains. Cascading impacts can lead to irreversible effects at various scales *(Adger et al., 2018)*.

Compound events can also be depicted in impact chains, which serve a better understanding of resulting interactions and accumulated risk. Compound events are understood as multiple hazards that contribute to societal and environmental risk *(Zscheinschler et al., 2018)*. Compound risks hence "arise from the interaction of hazards, which may be characterised by single extreme events or multiple coincident or sequential events that interact with exposed systems or sectors" *(IPCC, 2019)*. One **example** of risk

imposed by compounding SOP and EWE-related hazards on the livelihoods of coastal and small island communities is **sea-level rise combined with higher storm surges and resulting saltwater intrusion** which lead, together with prolonged periods of **drought**, to a **decrease of freshwater availability** *(GIZ and IIASA, 2021, 19)*.

Beyond that, **systemic risks** can result from interdependencies of events or effects, eventually leading to system malfunction or collapse. For example, the loss of infrastructure and crops as a consequence of compounding droughts and floods in Mozambique in the mid-2000s had a substantial adverse domino effect on key socio-economic outcomes such as housing, jobs, education levels, and social cohesion and can therefore be described as system malfunction *(GIZ and IIASA, 2021)*. It is essential to consider interconnectedness, non-linearity in cause–effect relationships of systemic risk, and potentially critical subsystems within the system of interest that can potentially fail or even reach tipping points.

Climate change-related hazards and impacts are shown in the spectrum developed by the GP L&D (Figure 6). The spectrum gives an overview of possible climate hazards and impacts that are – depending on the context – to be considered to avert, minimise, and address losses and damages from climate change.

The phenomena are often interlinked, and most regions in the world experience compound risks from EWE and SOP. Another example of a phenomenon appearing in several regions of the world is land and forest degradation, which decreases the ability of soils to absorb rainwater. This lowers the ecosystem's capacity to regulate heavy rain events. Consequently, floods and mass movements are more likely to occur and to cause losses and damages.

Climate change-related hazards and impacts can be primary, such as extreme rainfall or drought, or secondary, such as flooding or wildfire. Whereas the primary impacts are a direct result of changing climatic conditions, the secondary impacts represent subsequent effects and are often a result of multiple, including non-climatic, drivers such as land use, invasive species, or pollution that influence a determined system. Therefore, CRM that targets primary climate-related impacts and important other drivers can prevent cascading effects.

Depending on the specific context, some of the phenomena can be characterised specifically as EWE or SOP. However, droughts, for instance, hold aspects of both types of events; they are defined as natural phenomena that exist when precipitation stays below normal recorded levels. Besides being site-specific, the duration varies according to the impacts that are of interest.

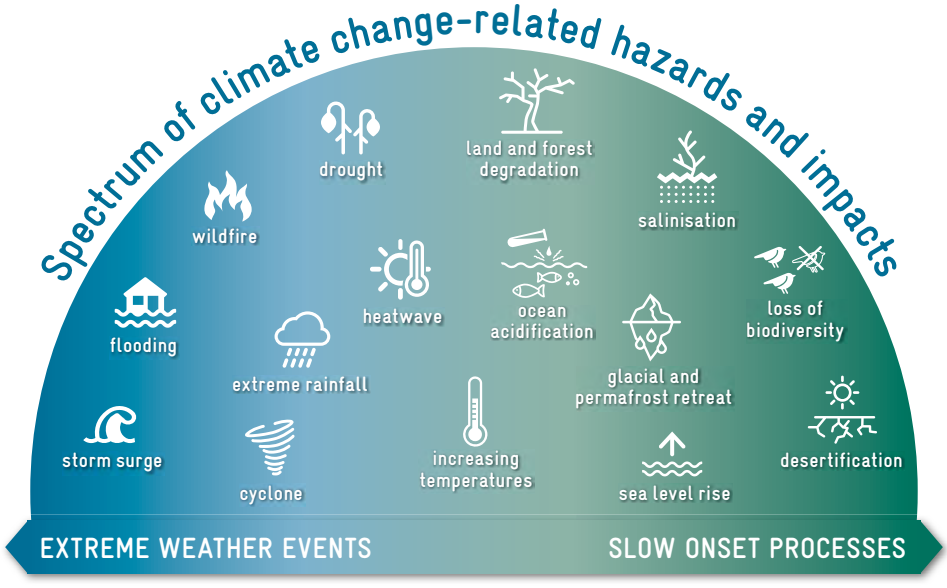


Figure 6: The GP L&D model of the spectrum of climate change-related hazards and impacts

The EWE and SOP depicted can be defined as climate hazards as well as impacts. In reality they are closely interlinked, and depending on the situation some events or processes can occur and be accounted for as hazard or impact. Sea-level rise, for example, can be a hazard for agriculture and livelihoods that manifests itself through salinisation.

Some references on the concept of loss and damage and, for the first time, a chapter on adaptation limits and constraints (in addition to opportunities) were published in the AR5 *(IPCC, 2014)*. The complexity of predicting thresholds (e.g. inhabitability thresholds of island states) and barriers or limits (e.g. limits of adaptation) is highlighted in recent Special Reports *(IPCC, 2018 and 2019)*. Residual risk is described as the "risk that remains following adaptation and risk reduction efforts" *(IPCC, 2019)*. The reports make clear that residual risk from climate-related hazards exists and will most likely do so in the future.

When specifically referring to SOP, the assessed literature mentions "limits of adaptation" rather than "residual risk". This limit is "the point at which an actor's objectives (or system needs) cannot be secured from intolerable risks through adaptive actions". Thereby soft adaptation limits are reached when "options may exist but are currently not available to avoid intolerable risks through adaptive action" and hard adaptation limits are reached when "no adaptive actions are possible to avoid intolerable risks" *(IPCC, 2019)*.

While looking at these definitions, an additional factor is significant: the risk tolerance of affected populations and individuals, which is closely connected to the local context. Intolerable risk potentially leads to loss and damage. However, there is as yet no method for clearly and objectively defining at which point a risk becomes intolerable.

Examples of where limits of adaptation may be reached include substantial loss of coral reefs, massive range losses for species, more human deaths from extreme heat, and losses of coastal-dependent livelihoods on low-lying islands and coasts *(IPCC, 2018)*.

4. Climate Risk Management

CRM as part of a comprehensive risk management approach

Irrespective of ongoing climate policy efforts, residual risk from climate change impacts remains in all countries for all plausible scenarios and could result in losses and damages. Climate change impacts are already being observed, and atmospheric greenhouse gas concentrations from past emissions will inevitably lead to a certain level of additional impacts. The AR6 confirms that:

- "Climate change is already affecting every inhabited region across the globe with human influence contributing to many observed changes in weather and climate extremes".
- "Global surface temperature will continue to increase until at least the mid-century under all emissions scenarios considered".
- "Many changes in the climate system become larger in direct relation to increasing global warming. They include increases in the frequency and intensity of hot extremes, marine heatwaves, and heavy precipitation, agricultural and ecological droughts in some regions, and proportion of intense tropical cyclones, as well as reductions in Arctic sea ice, snow cover and permafrost" *(IPCC, 2021)*.

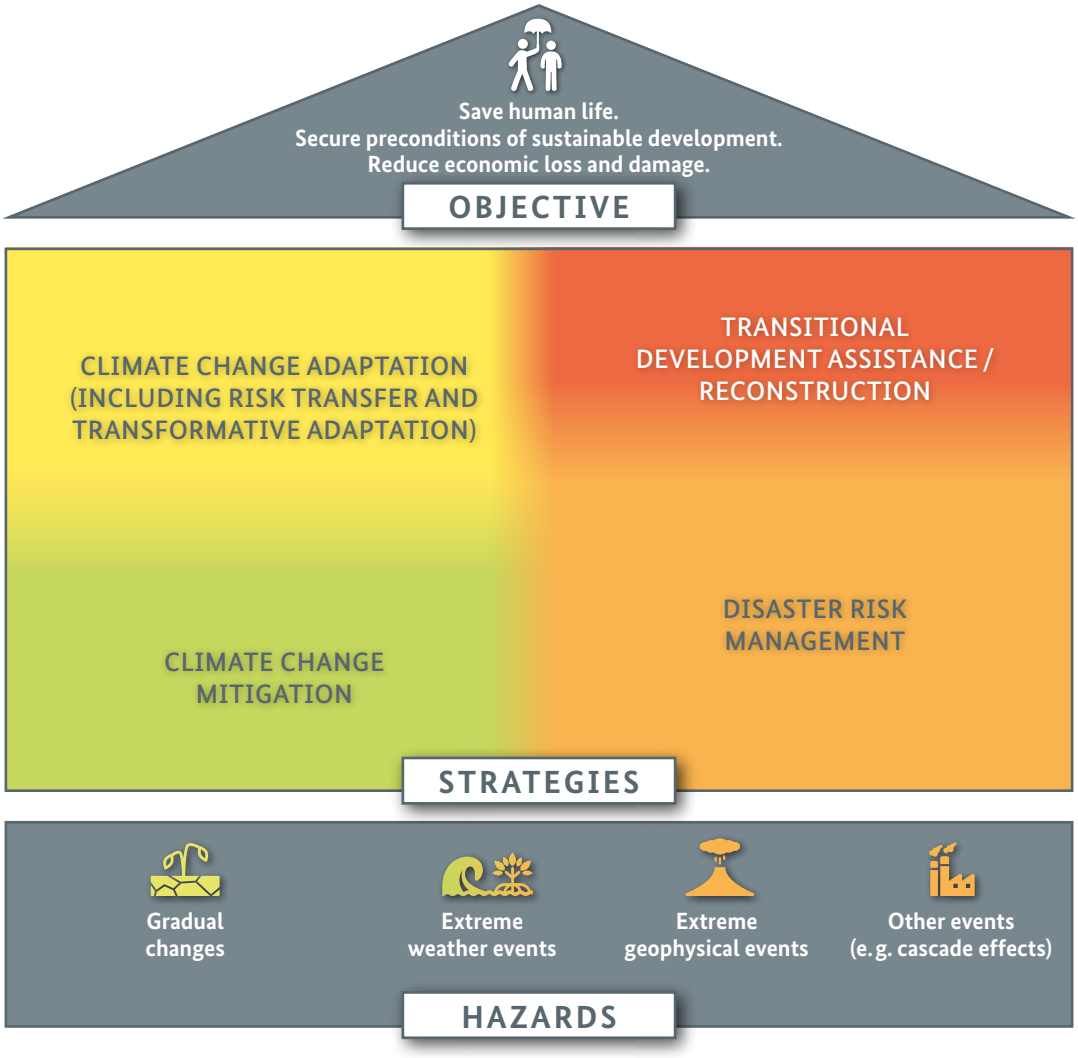


Figure 7: The BMZ's model for a conceptual approach of comprehensive risk management (BMZ, 2019)

In response to global warming and its potential consequences, the IPCC's SR1.5 advises to consider the wide range of possible adaptation options and urges to initiate the implementation of multi-sector and multi-level transformational change; all three IPCC Special Reports released in 2018/2019 state that many people are increasingly affected by the impacts of climate change and underline the advantages of system-based and comprehensive solutions for food security, resilience, and adaptation to climate change.

In this context, the concept of comprehensive (climate) risk management has gained traction in research, policy debate, and practice. According to the WIM, comprehensive risk management approaches "include risk assessment, risk reduction, risk transfer and risk retention. Such approaches aim at building long-term resilience of countries, vulnerable populations and communities to loss and damage, including in relation to extreme and slow onset events, including through: emergency preparedness; measures to enhance recovery, rehabilitation and build back/forward better; social protection instruments, including social safety nets; and transformational approaches".

This definition underlines that in addition to approaches that focus on averting losses and damages, once a disaster strikes, it is important that countries have systems in place to deal with immediate needs (e.g. humanitarian aid, emergency relief, contingency funds) and to restore livelihoods in a risk-informed way (e.g. preventive reconstruction). The BMZ has therefore developed the approach of Comprehensive Risk Management for Dealing with Disaster and Climate Risks *(BMZ, 2019)*, which offers strategies both to avoid and to respond to potential disasters, losses, and damages by combining measures from the portfolios of transitional development assistance and preventive reconstruction, mitigation, CCA (including risk transfer and transformational approaches), and DRR. This approach addresses climate-related risks from both EWE and SOP as well as non-climate-related disaster risks such as extreme geophysical events.

CRM represents one important component of comprehensive risk management which emphasises the assessment and management of risks caused or exacerbated by climate change. CRM links the international policy debate around the topic of L&D with (practical) actions at the national, sub-national, and local levels that can be implemented to deal with climate risks and losses and damages. Aligned with the need for up-scaled (transformative) adaptation and mitigation action, CRM is a cross-cutting approach requiring mainstreaming into development plans and sectors at all levels. It builds on existing efforts under climate change mitigation and adaptation, disaster risk reduction, and sustainable development, for instance by combining the expertise of the CCA and DRR communities to identify climate-related hazards, possible impact chains, and adequate adaptation measures for each specific context.

To support international as well as local efforts towards more effective management of climate risks, the GP L&D has developed a CRM framework to avert, minimise, and address losses and damages.

4.1 The CRM framework

The GP L&D's CRM framework (Figure 8) is a risk-based, iterative approach to managing climate-related risks, taking into consideration social, economic, non-economic, institutional, biophysical, and environmental aspects. It understands measures related to mitigation, CCA, DRR, and risk finance and insurance as complementary parts of the same toolbox. In order to attain the smartest mix of measures for a given situation, it links tried and tested measures with innovative instruments and transformational approaches in a comprehensive and integrated way.

In contrast to most other CRM approaches, the GP L&D's framework considers the entire spectrum of climate-related hazards, impacts and triggered risks (see Figure 6). It responds to risk from hazards related to short-term EWE such as storms and floods as well as to risk from hazards related to long-term SOP such as sea-level rise and desertification. Moreover, it takes into account the interdependencies between EWE and SOP, and the fact that both can occur at the same time. This is important because EWE and SOP are often interlinked, with most regions of the world experiencing compound and interacting EWE and SOP that cause cascading effects (see section 3 on interdependencies of risks). According to the AR6, "Many regions are projected to experience an increase in the probability of compound events with higher global warming (high confidence). In particular, concurrent heatwaves and droughts are likely to become more frequent" *(IPCC, 2021)*.

The CRM framework addresses decision-makers from national to local government levels, the private sector (especially micro-, small and medium-sized enterprises), and (re) insurance companies. Co-beneficiaries include ecosystems and local communities.

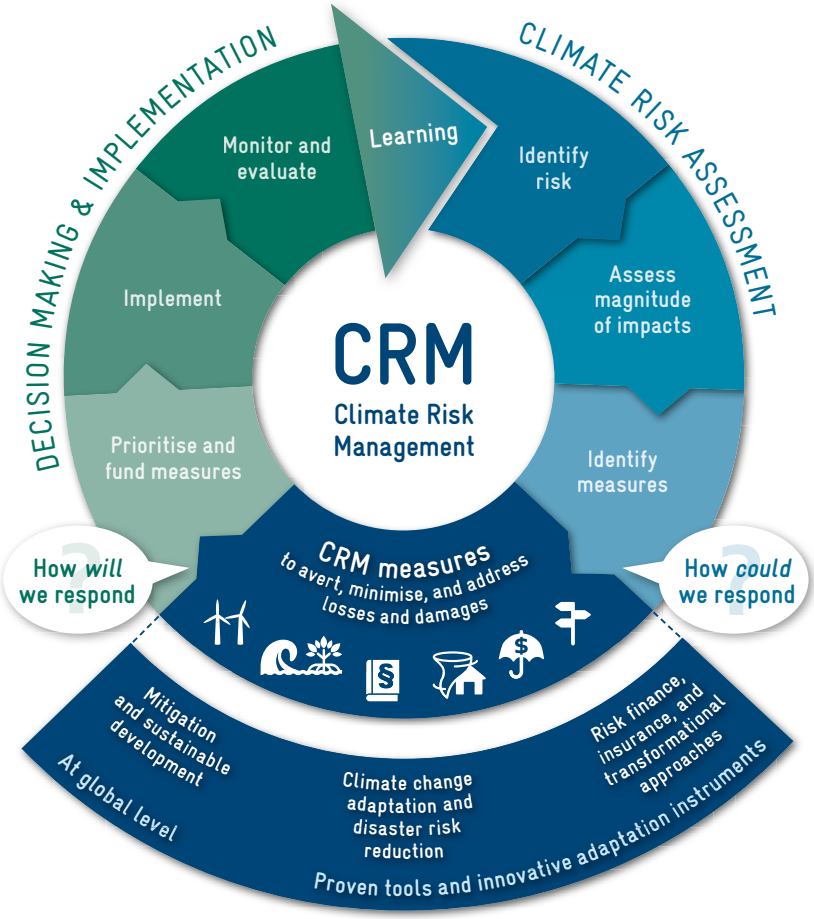


Figure 8: GP L&D model for CRM framework
Source: © GIZ / Global Programme on Risk Assessment and Management for Adaptation to Climate Change (Loss and Damage)

Climate-related risks alter with changing climatic conditions and need to be continuously analysed and addressed. The CRM framework operationalises CRM at scale within a dynamic learning framework, allowing for the updating of decisions over time. The outcomes of each individual step feed into succeeding steps, contributing to the development of a comprehensive CRM framework for the country or region concerned. This allows decision-makers to take account of fresh evidence and insights, newly available data, as well as lessons learnt from monitoring and evaluation. This flexibility is fundamental, especially for integrating innovative and transformative instruments and approaches.

A CRM cycle includes three main elements, namely climate risk assessment (CRA), CRM measures, and decision-making and implementation that are each separated into sub-steps (see Figure 8). The CRM logic commences with the assessment of climate risks, followed by the identification of a possible mix of measures, tools, and instruments to avert, minimise, and address potential losses and damages. The identified measures are then being prioritised, implemented, and monitored. The monitoring and evaluation process informs future decision-making and shapes the next cycle of CRM. In the following, the three main elements of the CRM framework will be presented in more detail.

4.2 Climate Risk Assessment

CRA builds the foundation for successful CRM. CRA aims to identify risks; assess the magnitude of impacts on people, assets, value chains, (critical) infrastructure, settlements and ecosystems; and ascertain the possible options for action. CRA can support evidence-based and risk-informed decision-making and planning in the context of climate change. It assesses risks by analysing one or several factors (hazard, exposure, and vulnerability) and the interaction between them. Suitable solutions are proposed based on the identification of the magnitude of impacts on people, assets, settlements, infrastructure, value chains, and ecosystems now and in the future. CRA shows possible options for action and answers the question: How could we respond? The integrated evaluation demonstrates effective measures for dealing with risks and forms the basis for the integration of climate policy measures into public budgets and national policies. In this way, decision-makers from the public and private sectors, along with other stakeholders, are supported in forward-looking planning.

The magnitude of impacts of different risks varies strongly depending on specific contexts, which is why CRAs should take as much contextual information into account as possible. As climate-related risks are highly context and location specific, it is crucial to customise the assessment to local, regional, national, and institutional contexts before identifying climate risks and assessing their potential impact. At the same time, CRAs should be as comprehensive as possible, accounting for multiple hazards and cascading risks, covering different sectors and disciplines of thought.

Hazards can be operationalised by introducing certain critical thresholds or frequencies for a chosen system of interest. Consequently, a CRA has to identify and measure multiple factors accounting for vulnerability and exposure as well as likelihoods. In order to grasp the multitude of factors for a given system in an encompassing way, different climate scenarios with differing possible impact levels, adaptation options, and socio-economic pathways can be employed. A risk-based approach thereby analyses present and possible future non-climate risk drivers (e.g. economic development or population growth) and their influence on exposure and vulnerability. Furthermore, acknowledging the complexity of such a web of intertwined factors, risk assessments try to focus on certain periods of time, geographical scopes, critical subjects (e.g. crops and livestock) and specific climate-related risks originating from, for example, sea-level rise.

Dimensions of CRA which pose challenges in the context of climate-related losses and damages are the inclusion of non-economic L&D, the forms of stakeholder involvement, the consideration of the entire spectrum of climate-related hazards and impacts, methods to account for interdependencies between risks, the coverage of socio-economic dynamics in the future, and the consideration of limits to adaptation. However, a forthcoming scoping study based on

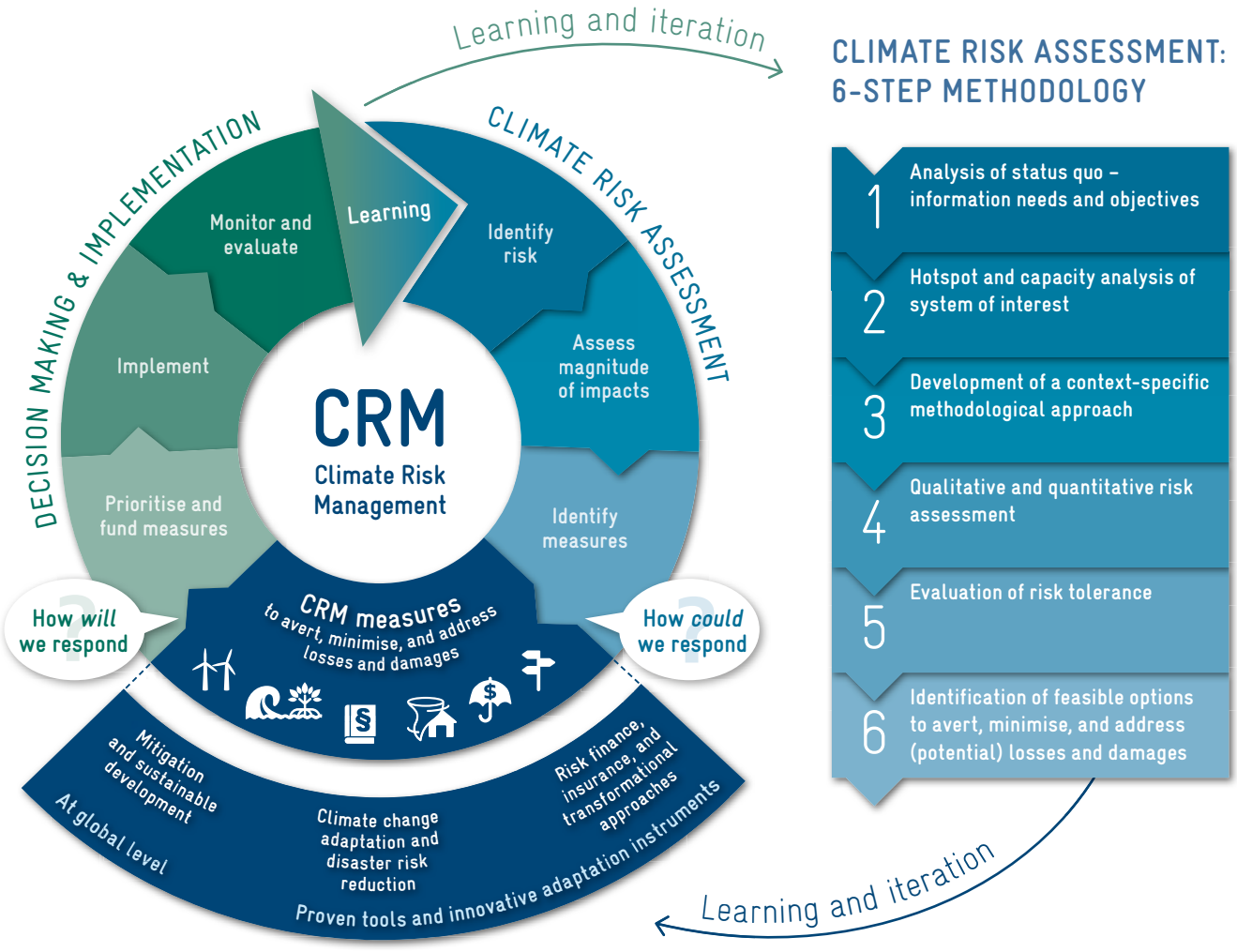


Figure 9: The GP L&D's 6-step methodology for climate risk assessment
Source: © GIZ / Global Programme on Risk Assessment and Management for Adaptation to Climate Change (Loss and Damage)

a comparison of 120 existing CRA methods *(GIZ, 2021c)* comes to the conclusion that some of the current approaches are not sufficiently comprehensive since they do not account for the various drivers and dimensions of risks, which can vary strongly according to specific contexts, and are often insufficiently responsive to the various demands of policy and practice. Many CRAs, for example do not consider the entire spectrum of hazards. Moreover, a common terminology and understanding of non-economic L&D is lacking.

To address these gaps, GP L&D has developed a 6-step methodology for CRA (Figure 9), which represents the first step of the CRM cycle and leads to the prioritisation of measures, decision-making, implementation, learning, and iteration.

The 6-step CRA methodology has been piloted in Tanzania and India. In Tamil Nadu, India, the CRA focused on EWE such as cyclonic storms and on the SOP of salinisation in the wake of sea-level rise and coastal inundation *(NIDM and GIZ, 2019)*. A comprehensive approach was applied that aligned top-down insight from expert-based methods and tools with bottom-up information on the risks to households and communities gathered through participatory processes. Field surveys and stakeholder engagement (including focus groups) at household and farm levels were complemented by impact chain assessment and desktop analysis including inventories of observed and modelled losses and damages. In Tanzania, the 6-step risk assessment has been applied at national and local levels (at Lake Rukwa) to ensure integrated water resources management is climate resilient in the face of increasing drought risk.

The 6-step approach consists of the following steps *(for a detailed description see GIZ, 2021b)*:

STEP 1: Analysis of status quo – information needs and objectives

When starting a climate risk assessment, one should review existing assessments and methodologies as well as the institutional landscape, relevant frameworks, and stakeholders. The guiding question in this step is *"What is the current state of knowledge?"*.

This step is based on a review of relevant literature and policy documents. For example, climate risk profiles of countries can be a useful source in this step.

STEP 2: Hotspot and capacity analysis of system of interest

Second, the system of interest is identified and its hotspots and capacities analysed. The guiding question is *"What region and sector are we looking at?"*. Aspects such as the relevance of sectors and livelihood strategies for the achievement of development objectives; the vulnerability of populations; and existing gaps in adaptation and risk management options play a role here. Spatial and historical data as well as a wide range of sources help to identify the system of interest. The final decision should be made in close consultation with national and local stakeholders.

STEP 3: Development of a context-specific methodological approach

Third, a context-specific methodological approach is developed. The 6-step approach does not suggest the use of a specific methodology, because each context differs in terms of data availability and different methods have different strengths and weaknesses. Thus, the final decision depends on the respective interests and goals of the assessment. The guiding question is: *"How can the magnitude of potential climate-related impacts be assessed in the system?"*

To decide on that, the practitioner should take into account the existing quantitative and qualitative approaches for assessing risks and impacts in the context, data availability, and costs of further data collection. Expected outcomes include the description of the methodology combining qualitative and quantitative approaches, also considering non-economic L&D, and an implementation plan and timeframe. This should happen in further consultation with stakeholders.

STEP 4: Qualitative and quantitative risk assessment

The fourth step comprises the conducting of the actual risk assessment. The guiding questions are *"What is at risk?"*, *"Where and from what?"*, and *"To which extent?"*. Current and projected climate change impacts should be identified, taking into consideration local socio-economic trends such as demographic change. Indicators to evaluate risk components need to be selected. Possible methods include risk modelling, indicator/scenario analysis, market price, and economic valuation or the compilation and improvement of impact chains. Qualitative assessments and consultation of

IMPACT CHAINS AND DEVELOPMENT PATHWAYS

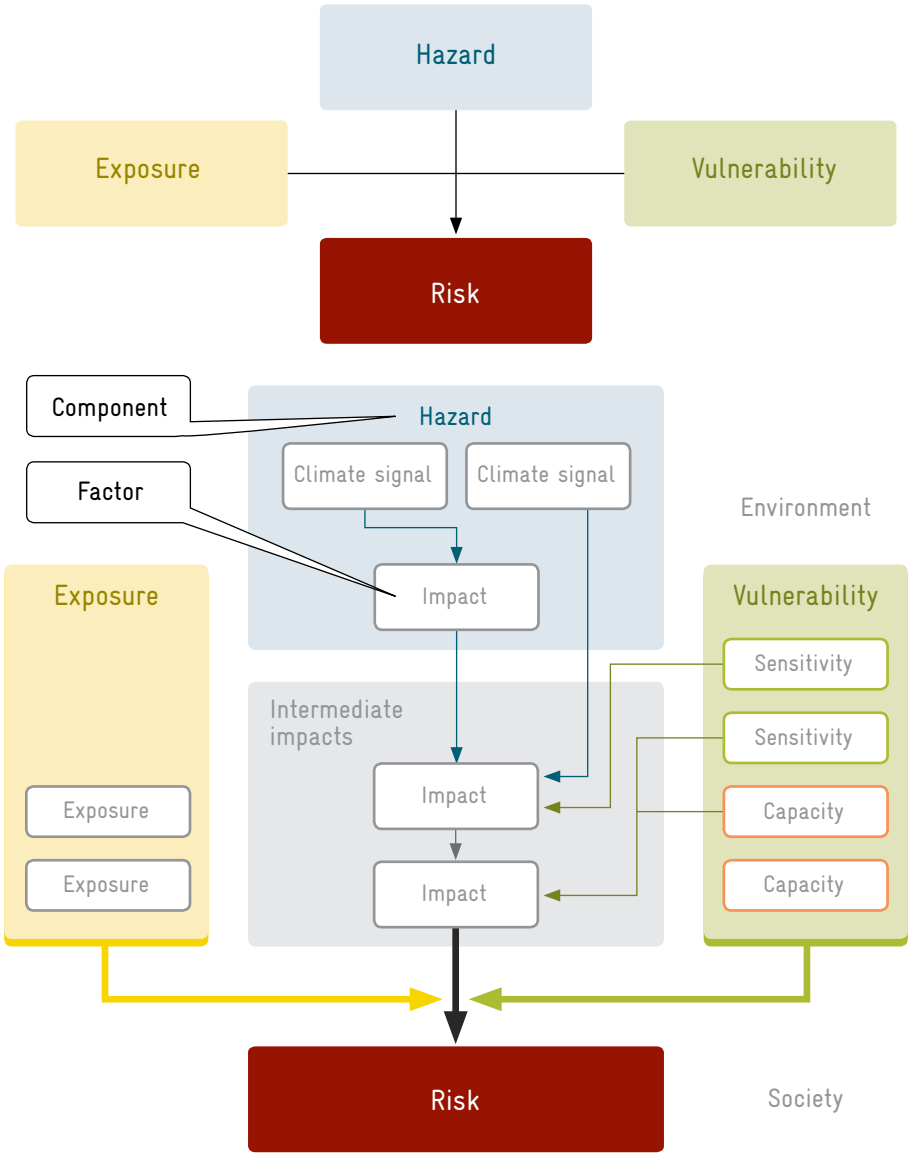


Figure 10: Impact chain (GIZ and Eurac, 2017)

An **impact chain** is an analytical tool that helps to better understand, systemise, and prioritise the factors that drive risk in the system of concern. Figure 10 shows that an impact chain consists of risk components (hazard, vulnerability, exposure) and underlying factors, like sensitivity and capacity. Vulnerability – consisting of sensitivity and capacity – and exposure mediate the possible impact of a hazard and, together with its likelihood, create the risk. As vulnerability and exposure can be changed through development pathways, the role of collective agency in reducing and managing climate risks are included in the equation. The SR1.5 states that climate risks, among others, depend on "levels of development and vulnerability, and on the choices and implementation of adaptation and mitigation options" (IPCC, 2018). Vulnerability can be reduced by decreasing sensitivity or by increasing adaptive or coping capacities. Generally, adaptation measures can also focus on reducing exposure, e.g. through relocating processes (GIZ, 2017). An impact chain can be used to operationalise the different risk components into measurable indicators. How these indicators influence each other can then be the basis for understanding the system of interest.

stakeholders may be considered as sources of information in cases where data is lacking. The assessment should result in the presentation of a combination of different suitable CRM measures, including information on costs, benefits, and framework conditions.

STEP 5: Evaluation of risk tolerance

Next, the risk tolerance of the population should be evaluated, always keeping in mind that risk tolerance highly depends on the economic situation of people. The guiding question is *"What level of risk tolerance does the affected population exhibit?"*.

Field surveys and/or focus groups on risk perception combined with expert judgements on levels of risk tolerance should result in an assessment on whether the identified risk is acceptable (no further actions necessary), tolerable (further incremental actions required to manage risk), or intolerable (transformational actions necessary to avoid risk). In this step, it is important to compare different interconnected climate-related risks with non-climate-related risks, such as general health or accident risks. It should include a quantitative assessment of the extent of associated risks as well as qualitative (subjective) perceptions as an outcome, and an evaluation of response mechanisms, reaching from incremental to transformational adaptation.

STEP 6: Identification of feasible options to avert, minimise, and address (potential) losses and damages

Finally, feasible options to avert, minimise, and address (potential) losses and damages are identified. The guiding question is *"How can we respond using the identified CRM measures from steps 4 and 5?"*. It should be considered which measures can effectively prevent or reduce potential losses and damages, at what costs and to what extent, as well as which constraints (financial, institutional, or technical) need to be considered. Instruments such as stakeholder-based elicitation of options, cost–benefit analysis, robust decision-making approaches, multi-criteria analysis, and adaptation pathways can be combined in different ways. The aim is to provide a detailed overview of possible CRM interventions including risk levels, relevance, and feasibility. As a final outcome, taking into account what respondents and decision-makers consider feasible and relevant, policy-relevant information to support decision-makers in forward-looking planning and implementation of measures is provided, resulting in an answer to the question *"How will we respond?"*.

4.3 The CRM measure toolbox

The final step of the GP L&D's 6-step methodology for CRA is to support stakeholders in identifying feasible options from the portfolio in their particular context. CRM relies on the strong participation of stakeholders from different sectors and at different levels. It proposes a diverse set of measures that stakeholders can choose from, enabling them to take timely action to enhance preparedness for climate change-related EWE and to strengthen overall resilience, including to SOP.

The language of averting, minimising, and addressing losses and damages from climate impacts emerged from political negotiations on the topic under the UNFCCC. CRM measures can be broadly assigned to the three different categories, although some measures take effect in more than one category, making them even more effective. CRM measures do not have to be reinvented specifically for climate change since a wide range of tried and tested tools and instruments do exist and are being applied in various sectors, without always being associated with climate change – in land-use planning, watershed management, insurance schemes, or nature-based solutions, just to mention a few.

Averting losses and damages through mitigation and sustainable development

The first set of CRM measures aims at averting the very emergence of losses and damages. Climate change exacerbates hazards such as flooding or changing rainfall patterns. The intensity, frequency, and/or duration of future climate-related hazards depend largely on the global emissions pathway of the coming years and decades. Limiting global warming to well below 2° C, and preferably to 1.5° C, compared to pre-industrial levels is of paramount importance in keeping climate-related risks manageable. Risk results from the interaction of vulnerability, exposure, and hazard. While the occurrence of anthropogenic climate change-induced hazards can be reduced through climate change mitigation measures, the exposure and vulnerability of people and assets are mainly linked to sustainable development indicators and CRM. While humanity will benefit from mitigation measures in terms of reduced climate risks only in the middle to long term, exposure and vulnerability can be reduced comparatively quickly, for example through risk-informed development that calls for risk analysis and wise management.

Some useful measures in terms of mitigation and sustainable development include using renewable energy, switching to low-carbon transportation and lifestyles, and protecting or expanding carbon sinks like forests. These measures offer multiple co-benefits such as better air quality and energy access.

Minimising losses and damages through CCA and DRR

The second set of CRM measures aims at minimising those losses and damages that occur despite mitigation action and sustainable development. This set of measures combines approaches from CCA and DRR (in particular disaster preparedness measures) that have proven effective. For example, it might be too late to fully avert glacier melt and its various impacts, but we can build dams at growing glacial lakes as an adaptation measure and thereby avert losses and damages from possible glacial lake outburst floods. Other useful adaptation measures include afforestation of mangroves, agroforestry, climate-smart agriculture, and ecosystem-based adaptation.

Since EWE are already increasing in intensity and frequency, in addition to adaptation, we must make effective use of disaster preparedness measures such as early warning systems, contingency planning, and civil protection plans to minimise losses and damages, e.g. from storms or floods.

By employing measures from CCA and DRR, the CRM framework bridges the two communities and does not narrow down the toolbox of possible actions to either one skillset. This allows for the identification of a context-specific and appropriate set of measures in cooperation with local stakeholders and expertise from both communities.

Addressing losses and damages through risk finance and transformational approaches

The third set of CRM measures addresses residual losses and damages that are not avoided or minimised. This requires new, innovative ways of thinking. One way of addressing residual losses and damages is through risk finance mechanisms such as climate risk insurance, contingency funds, and social protection schemes. These mechanisms provide security against the loss of assets, livelihoods,

and lives, and ensure reliable and dignified post-disaster relief.

Climate risk insurance as one means of risk transfer can enable more resilient economic development, and eventually strengthen disaster preparedness and rapid response to and recovery from climate shocks. Combined with other measures under the paradigm of CRM, it can be even more effective, altering insurability and thus lowering premiums. While climate risk insurance is emerging as a preferred risk transfer method, including both traditional indemnity-based insurance and innovative index-based solutions, it is important to be aware of the limited applicability of insurance products to climate change in general and in developing countries in particular. Some general considerations include the potential un-insurability associated with increasing frequency and magnitude of EWE and the unsuitability of traditional insurance for SOP such as sea-level rise and desertification *(Warner et al., 2009)*. Further challenges arise from unaffordability of insurance for households or private and public entities, unavailability of suitable insurance models, and restricted coverage of insurance schemes. Within developing countries, certain problems limit the usage of risk insurance which can be categorised as resulting from: (1) the problem of solvency and sustainability of insurance systems; (2) inefficiencies and market distortions arising from outside support; (3) moral hazard, adverse selection, and basis risk; and (4) problems of institutional stability, public confidence, and trust *(Linnerooth-Bayer and Mechler, 2008)*. In addition, premiums for direct and sovereign climate risk insurance schemes may be unaffordable for poor households or even countries, eventually calling for premium subsidies by developing partners or multilateral finance mechanisms.

Risk pooling or sharing at national, regional, and global levels represents another promising risk finance instrument by which countries can help each other overcome challenges related to climate change. Initiatives such as the Caribbean Catastrophic Risk Insurance Facility, African Risk Capacity, or the Pacific Catastrophe Risk Assessment and Financing Initiative lead the way and should be closely followed to assess their potential for replicability and scalability. Again, smart and sustainable CRM measures have high potential for reducing risks and thus reducing premiums at the same time.

In addition to risk finance, transformational approaches are needed to effectively address residual losses and damages. The IPCC strongly backs the case for transformational adaptation in order to foster climate resilience *(IPCC, 2014)*. While incremental adaptation "maintains

the essence and integrity of a system or process at a given scale", transformational adaptation "changes the fundamental attributes of a socio-ecological system in anticipation of climate change and its impacts" *(IPCC, 2018)*. Such approaches include the diversification of livelihoods, flexible and participatory decision-making, and adaptive management approaches. This can imply deep institutional, regulatory, economic, and behavioural changes. A concrete example of this is human mobility: migration (and, as a last resort, planned relocation) can be a way of diversifying income sources and enabling alternative livelihoods, as well as a precautionary strategy to avoid the third form of climate-induced human mobility, displacement. While conventional adaptation would incrementally increase sea walls to manage flooding, transformative adaptation would approach the exposure of people and livelihoods by considering vacating affected areas *(Mechler et al., 2018)*.

4.4 Decision-making, implementation, and learning

To identify the smartest mix of CRM measures for a given context, it is crucial to understand the organisational and economic ability of countries, communities, and the private sector to adapt and respond to risk. These factors are key in the prioritisation of CRM measures that can ensure climate-resilient development pathways. Due to the partly subjective nature of risk assessment, it is not possible to identify the most appropriate CRM measures in each context solely through cost-benefit analysis. Many important aspects cannot be quantified and/or monetised but might have a significant impact, especially on vulnerable groups. Prioritised CRM measures must be context-specific and sustainable, and they must engage affected and marginalised populations through stakeholder participation. The different steps in the GP L&D's CRM framework enable decision-makers from the public and private sector to better prioritise, fund, and implement options *("How will we respond?")*. Monitoring and evaluation of implemented measures lead to continuous learning that feeds into the CRM cycle and informs future decisions.

Institutional integration is crucial for mainstreaming CRM considerations into new and existing development planning and budgeting processes, within all relevant institutions and sectors, and at all levels. The SR1.5 confirms the significance of this approach by finding with high confidence that "future climate-related risks would be reduced by the upscaling and acceleration of far-reaching, multi-level and cross sectoral climate mitigation and by both incremental and transformational adaptation" *(IPCC, 2018)*. The GP L&D's CRM framework supports this approach by taking into account the options that arise through promoting mitigation and sustainable development, through bridging CCA and DRR, and eventually through transferring risks and transformational approaches.

An important goal of the GP L&D's CRM framework is to mainstream climate risks into relevant processes and policies at the national and sub-national level, aiming at: (1) fostering a holistic consideration of climate change impacts and DRR in affected sectors and pointing out the need to manage losses and damages as well as the possibilities for achieving this; (2) strengthening inter-ministerial coordination; and (3) filling identified gaps to effectively assess and manage losses and damages (e.g. through the development of specific instruments, specific data collection, appropriate human and financial resources, and institutional rearrangements).

Mainstreaming CRM into national and sub-national (development) planning responds to the three big post-2015 agendas – the Sendai Framework, Paris Agreement, and 2030 Agenda. Implementing CRM with these grand agendas in mind can then translate synergies from the international level to the national or sub-national levels. Currently, viable formats for CRM to be included are National Adaptation Plans (NAPs), Nationally Determined Contributions (NDCs), and reporting for the Sendai Framework.

CRM and the NAP process

The NAP process offers a suitable opportunity to incorporate dealing with potential losses and damages at the national level. The NAP process helps to identify appropriate adaptation options and strategies, based on comprehensive climate change risk and adaptation assessments. It also integrates adaptation into national policies and implementation strategies. This implies required capacity development and institutional rearrangements. Framing loss and damage within the adaptation context as a subset of the NAP process offers a chance to broaden the scope of these elements, making use of additional tools and methods specific to loss and damage and other particular areas of concern, and thereby enhance the comprehensiveness of the NAP process. Figure 11 below shows how concerns for loss and damage can be integrated into the NAP creation process *(GIZ, 2017)*.

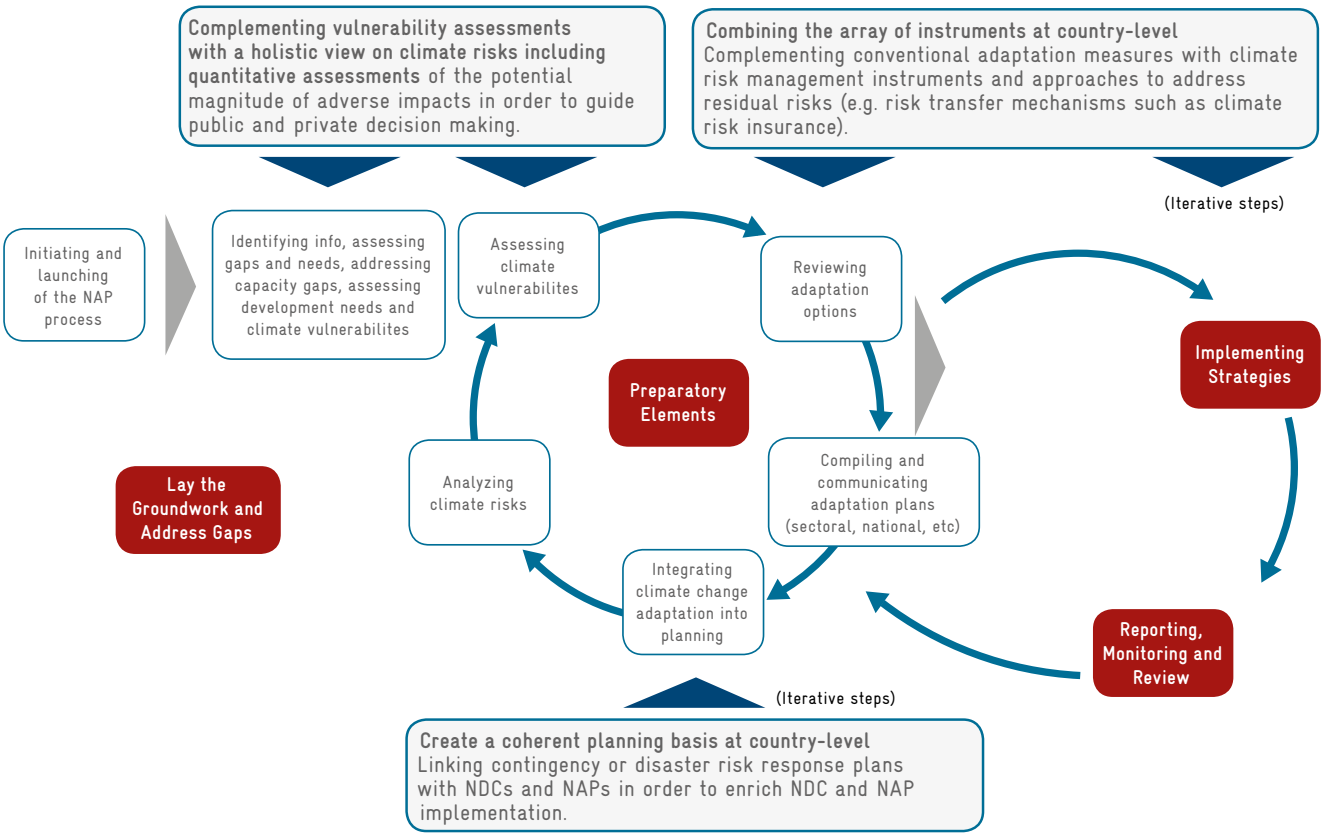


Figure 11: How CRM can help the NAP process (GIZ, 2017)

In order to align CRM and the NAP process, it is crucial to: (1) enhance policy coherence and institutional cooperation; (2) combine the array of instruments at the country level; (3) use risk analysis as a guide for public and private decision-making; and (4) share experience *(GIZ, 2017)*. Saint Lucia's NAP, submitted in September 2018, functions as a good practice example, as it includes a separate chapter on loss and damage that describes the ways in which CRM addresses loss and damage by strengthening resilience. It details possible actions for risk assessment, reduction, transfer, and retention, such as hazard mapping, early warning systems, and continued engagement in regional risk pooling, livelihood protection policies, and insurance platforms *(Government of Saint Lucia, 2018)*.

In addition, CRM should be integrated in NDCs to enhance policy coherence and institutional cooperation and promote CRM as an effective tool to manage losses and damages. By strengthening the link between CRM and NDCs, the intertwinement with the Sendai Framework and the SDGs is facilitated, thereby increasing national policy coherence and improving the cooperation of the CCA and DRR communities with respect to data sharing. Loss and Damage is mentioned in the NDCs of 35 countries *(DIE, 2021)* and roughly 120 NDCs refer to adaptation in general *(GIZ and Eurac, 2017)*.

4.5 Further aspects of CRM

Oceans and coasts

The interrelationship of climate and the ocean is manifold, and the impact of climate change on oceans and coasts is highly complex. The ocean is home to the majority of life on earth and it is the world's largest carbon sink. To date, it has absorbed about 30 % of carbon dioxide emissions from human activity since the industrial age *(IPCC, 2013)*. It stores vast amounts of excess atmospheric heat, generates half of our biosphere's oxygen, and acts as the great regulator of global climate. While the importance of the ocean is clear, what is also becoming apparent is that the interaction between the atmosphere, the ocean, and coastal communities is being profoundly affected by climate change. Direct and indirect effects of climate change range from increasingly frequent and severe storms and flooding events to the warming and acidification of ocean waters. These effects are causing a degradation of biodiversity, migrations of species into new habitats (in many cases towards the poles), coastal erosion, loss of land, and salinisation of coastal soils due to rising sea levels. The trend of more frequent and severe EWE is projected to accelerate. Mutually reinforcing effects will challenge

the adaptive capacity of communities and ecosystems on small islands and in coastal zones in particular, and present an increasing risk of significant losses and damages For further details on the consequences, especially for coastal communities, see GIZ *(2021)*. In addition, entire sectors are being affected. In 2017, fish accounted for 17 % of global animal protein intake *(FAO, 2020)*. This proportion was significantly higher in some of the Least Developed Countries and Small Island Developing States. In many coastal regions, the small-scale fishing sector is the main source of income alongside tourism. Over 97 % of all people who are dependent on capture fisheries (120 million people) work in developing countries, and most of these – over 90 % – are involved in small-scale fisheries *(FAO, 2020)*. Despite the importance of small-scale fisheries globally, they are particularly vulnerable to the current and projected impacts of climate change. Changing migration patterns of some pelagic fish (e.g. tuna), the degradation of coral reefs, and the destruction of fishing equipment and infrastructure in storms and floods are only some examples of how the sector is being seriously affected. Many anthropogenic stressors, including overfishing and pollution, are exacerbating the problem.

CRM offers entry points for addressing risk from a changing climate more comprehensively. To be effective, CRM should be applied as multi-dimensional and multi-sectoral approach focusing on the needs of the most vulnerable. In the context of small-scale fisheries, for instance, CRM should aim at providing food security and eradicating poverty in fishing and maricultural communities. This includes developing the potential for transformation (e.g. alternative or supplementary income sources) in order to provide fishers with temporary or permanent options to diversify or to leave the sector. In order for CRM to be effective, local stakeholders, e.g. fishermen and -women, must be involved, guiding policy frameworks must be in place, and knowledge must be derived and shared. Further detailed entry points of CRM in the context of the ocean and coasts are portrayed in GIZ *(2021)*, and for the case of small-scale fisheries in GIZ *(2021a)*.

Gender dimensions of CRM

In many countries, significant socio-economic inequalities between men and women still limit or prevent women's access to education, property, financial assets, technology, political decision-making, and other resources. These gender-discriminatory norms limit women's adaptive capacity and prevent them from developing stronger climate resilience. Women in developing countries, in particular, are at increasingly high risk of suffering losses and damages. It is therefore of utmost importance and necessity to integrate gender considerations into CRM in order to avert, minimise, and address losses and damages.

There is scientific evidence for the gender-specific impacts of climate change on women in different developing countries, for example concerning past and potential future losses and damages specifically for women. Social standards can create, enhance, and determine both vulnerability and resilience in the context of climate change. Information analysed in GIZ *(2020)* shows that:

- EWE cause women and children to suffer higher mortality and morbidity due to socially constructed roles and norms that determine their behaviour and actions.
- Women's and girls' health are projected to be disproportionally affected by the impacts of climate change as a result of unequal access to health care, nutritious food, water, sanitation, information, and technology.
- Women and girls have restricted access to certain adaptation strategies (e.g. migration) due to different roles and responsibilities.
- In the aftermath of an EWE, women and girls face higher risk of experiencing gender-based violence, human trafficking, and sexual exploitation.
- Women and girls face higher loads of care work, resulting in various long-term effects on their education and income generation.
- Women's and girl's losses and damages due to climate change impacts are often not part of the formal economy and do not directly reflect monetary value and, therefore, can mostly be categorised as non-economic losses and damages.

Since the first UNFCCC in-session workshop on gender and climate change at COP19 *(2013)*, the topic is becoming increasingly prominent within the scope of the UNFCCC and the NAP processes as well as the NDC partnership. The successful review and adoption of the Lima Work Programme on Gender and the Gender Action Plan at COP25 *(2019)* show that Parties continue to commit to gender mainstreaming as a significant component of international climate dialogue, policy, and action.

The GP L&D CRM framework combines gender and climate action to effectively deal with losses and damages from climate change. Due to still existing structural gender inequalities and social biases, women's contribution to adaptation and climate action has not yet reached its full potential. Gender-responsive CRM can, therefore, create win–win options that enhance both climate action and social equality. Additionally, gender-responsive adaptation, mitigation, and financing measures have the potential to challenge existing paradigms and create cultural shifts for gender norms. They therefore hold high potential for being inherently transformative.

Gender dimensions can be included in each step of the continuous CRM learning cycle. This way, it can be used as a tool to recognise, validate, and integrate women's resources into decision-making, planning, implementation, and monitoring processes – which will benefit the entire society.

Drawing on knowledge gaps and limitations for enhanced climate policy and action, the GP L&D has developed recommendations on how to set the focus for gender-responsive CRAs and research which aim at broadening the knowledge basis as well as the scientific evidence for this very topic. Instructions for the design, selection, implementation, and monitoring of CRM measures aim at supporting the integration of gender lenses into all phases of the CRM framework to successfully address and minimise climate risks and enhance social inclusion *(GIZ, 2020)*.

By explicitly focusing on the social preconditions and dimensions while planning and implementing climate policy and action, these tools have the capacity to become transformative measures, enabling a just transition towards a more resilient and equal society.

Coherence between CRM and the SDGs

The 2030 Agenda for Sustainable Development encapsulates a global commitment to end poverty and promote social and economic development while ensuring healthy ecosystems and addressing climate change. It also includes a key pledge by UN member states to *"leave no one behind"* – a commitment to not only ensure that the SDGs are achieved by all countries on a national level, but also to reach population groups within countries who are vulnerable due to geography, gender, socio-economic forces, age, or status as minorities or indigenous peoples *(UN, 2015)*. The role of sustainable development itself in averting losses and damages should not be underestimated. While mitigation measures such as low-carbon strategies are concretely useful in reducing global warming, sustainable development can substantially contribute to reductions in exposure and vulnerability.

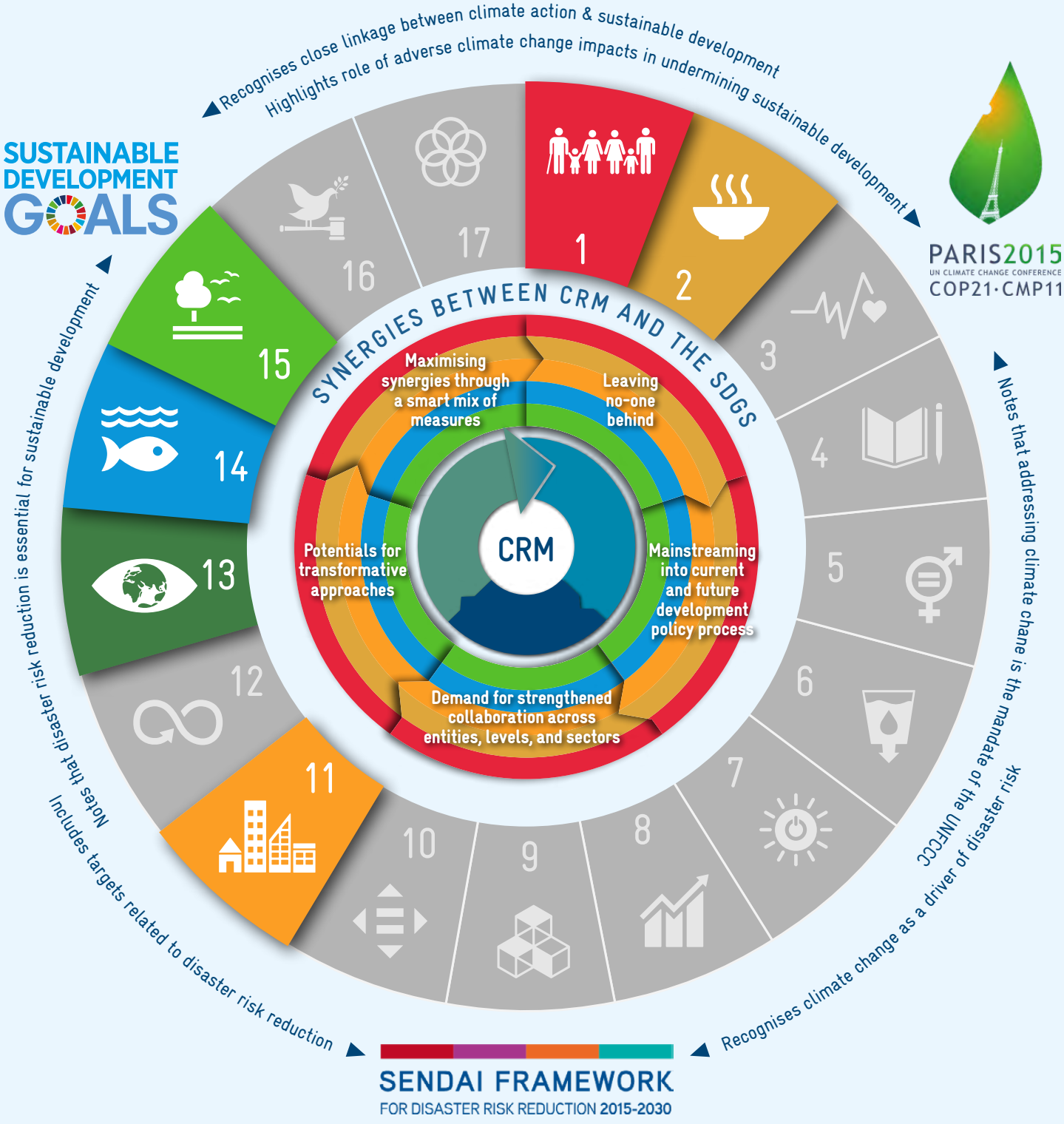
Climate change in contrast is threatening recent development gains and slowing progress towards the SDGs *(Denton et al., 2014)*. Integrating CRM measures into the implementation of policies and strategies aimed at achieving the SDGs is required to promote social, environmental, and economic sustainability, while partly averting, minimising, and addressing losses and damages from climate change. While the need for climate-resilient development has been well acknowledged *(Roberts & Pelling, 2018)*, there are limited examples of what it looks like, and there is limited expertise in achieving it at the national or local level *(Dazé et al., 2018)*.

Multiple synergies exist between the individual SDGs and CRM. While SDG 13 recognises the role of the UNFCCC in achieving climate action, it also points to the necessity of including specific climate action measures into policies and planning, and of strengthening resilience and adaptive capacity, not only to climate-related hazards but also to disaster risks. Other goals with particularly strong synergies with CRM are SDG 1 (No Poverty), SDG 2 (Zero Hunger), SDG 11 (Sustainable Cities and Communities), SDG 14 (Life below Water) and SDG 15 (Life on Land) *(GIZ, 2021d)*. There are numerous examples of CRM measures that have been shown to create enabling synergies with these SDGs, including risk transfer mechanisms such as climate risk insurance schemes, social protection schemes, ecosystem-based adaptation measures, capacity development and awareness raising strategies, and integrated planning/management approaches *(for more information see GIZ, 2021d)*.

When implemented together as part of a holistic framework, CRM can potentially function as a vehicle for both addressing climate change and promoting sustainable development, thereby contributing to the achievement of the SDGs *(e.g. Roberts & Pelling, 2018)*. For instance, adaptive social protection integrates social protection, disaster risk management, and climate adaptation to help build the resilience of poor and vulnerable households in the face of multiple interacting risks, including from natural hazards, poverty, economic crises, pandemics, climate change, and conflicts *(UNU-EHS, n.d.)*. At the same time, the planning of CRM requires pre-analysis of potential trade-offs between CRM measures and SDGs as well as remaining research gaps of the impacts of some CRM measures. This underlines the need for an advanced framework for assessing interlinkages as a baseline for advancing and implementing integrated approaches in the future.

Institutional integration is crucial to create such holistic frameworks and to mainstream CRM and considerations in the context of losses and damages into new and existing development, adaptation, and budgeting processes, within all relevant institutions and sectors *(GIZ, 2021d)*. At present, strategies to include CRM considerations into national policy rely on their strong linkage to, and possible integration into, current processes such as NDCs, NAPs, development plans, and disaster risk reduction and management policies, as well as the reorientation of national policies towards sustainable development.

Opportunities for strengthening synergies between CRM and the SDGs



5. Conclusion and the way forward

Effectively addressing losses and damages related to current and future climate change represents a significant challenge to nations as well as the international community. However, addressing losses and damages does not have to start from scratch. It can in fact build on many strongly related processes, strategies, and instruments known from climate change mitigation and adaptation, disaster risk reduction, risk finance and insurance, and sustainable development pathways. All of these approaches are effectively combined in the GP L&D's CRM framework, and supplemented with innovative and transformational instruments and approaches. In addition, when a disaster strikes, it is important that countries have systems in place to deal with immediate needs (e.g. humanitarian aid, emergency relief, contingency funds) and to restore livelihoods in a risk-informed way (e.g. preventive reconstruction). This is reflected in the approach of Comprehensive Risk Management for Dealing with Disaster and Climate Risks developed and promoted by the BMZ.

The IPCC emphasises that "Adaptation options specific to national contexts, if carefully selected together with enabling conditions, will have benefits for sustainable development and poverty reduction with global warming of 1.5°C" (IPCC, 2018). This highlights the synergy effects arising from effective CRM and achieving the SDGs. Achievement of the SDGs can only be realised through building resilience for development pathways. Additionally, sustainable development can enable societal and system transitions and transformations which in turn facilitate adaptation efforts. Finally, it is crucial to emphasise the economic benefits of CRM, as opportunity costs show that anticipatory planning pays off and present investment will save considerable money in the future.

The following approaches have high potential to support the development of a comprehensive and integrated CRM approach, at national and international levels.

Foster cooperation, capacity building, and learning

- ✓ Foster dialogue and raise awareness about losses and damages as well as comprehensive CRM approaches, e.g. through programmes offering capacity development and dialogue facilitation, involving relevant institutions at national and sub-national levels.
- ✓ Communicate and prove the benefits of risk-informed behaviour and management within the public and private sectors, e.g. with respect to climate risk-informed investments, infrastructure, and value chains.
- ✓ Support a holistic and adaptive approach that links communities, local and regional authorities, and national action.
- ✓ Mainstream climate risks into relevant processes and policies at national and sub-national levels; mainstream CRM into national and sub-national development planning.
- ✓ Strengthen inter-ministerial coordination and dialogue and cooperation between the DRR and CCA communities of practice.
- ✓ Partner with multiple stakeholders, adopting a whole-of-society and whole-of-government approach (public, private, communities, cities, knowledge centres, media, etc.) and strengthen the involvement of decision-makers and populations at risk in order to increase buy-in and facilitate implementation.
- ✓ Implement robust monitoring, evaluation, and learning frameworks that feed back into an iterative integration process to flexibly adjust implementation of CRM measures and to inform future decisions and resource allocations.

Improve CRA and the data it is based upon

- ✓ Improve existing approaches and methodologies to assess actual and future climate-related risk based on existing methodologies from the fields of CCA and DRR, such as risk assessments and post-disaster needs assessments, keeping in mind that CRM is context-specific: there is no universal solution.
- ✓ Improve the data for CRA and make it publicly available, e.g. through long-term monitoring of SOP and national climate impact projections. Access to quantitative and long-term data at the national level is essential to assessing risk, particularly for SOP for which data is often missing or insufficient.
- ✓ Facilitate technology transfer on new (and digital) technologies which can improve data collection for CRA, for example through satellite systems and drones.
- ✓ Collect and/or translate data for all levels and relevant stakeholders – the private sector, farmers, and local communities need different kinds of information, for instance.
- ✓ Make sure data is collected and analysed in a disaggregated way so that the measures that are prioritised reach the most vulnerable, including women, children, the elderly, indigenous people, migrants, people with disabilities, and the poorest.
- ✓ Use participatory approaches to identify and prioritise measures to enhance local capacities and ensure the suitability, buy-in, and sustainability of measures.

Improve and promote CRM measures, and test them on the ground

- ✓ Consider a wide portfolio and combination of CRM measures from DRR and CCA and engage various sectors and systems to address multiple and context-specific risks.
- ✓ Identify the most effective mix of measures in a context-specific way and based on participatory approaches to enhance the suitability, acceptance, effectiveness, and sustainability of the measures.
- ✓ Identify gaps and expand the portfolio of effective CRM measures – e.g. with approaches that address non-economic losses and losses and damages from SOP – using innovative instruments to finance CRM measures, including risk finance, contingency planning, risk insurance, and early warning.
- ✓ Support climate risk insurance schemes that reward risk-informed planning and behaviour, keeping in mind that premiums need to be affordable or have to be subsidised for the poor.
- ✓ Promote CRM measures that offer multiple co-benefits. For example, nature-based solutions combine climate change mitigation, adaptation, DRR, biodiversity conservation, and sustainable resource management; early warning systems facilitate effective DRR and CCA at the same time because they empower populations at risk to initiate timely actions to reduce the impact of climate-related hazards.
- ✓ Do no harm: Avoid CRM measures with negative side-effects on long-term social and ecological resilience.
- ✓ Generate experience and good practices through concrete piloting or implementation of activities and projects. In particular, the applicability of CRM measures to different SOP still needs testing on the ground.
- ✓ Make sure approaches are conflict- and gender-sensitive.

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