Integrating slow onset processes into climate risk management

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Abbreviations

ASP	Adaptive Social Protection
AOSIS	Alliance of Small Island States
CCA	Climate Change Adaptation
COP	Conference of the Parties
CRA	Climate Risk Assessment
CRM	Climate Risk Management
DEval	German Institute for Development Evaluation (Deutsches Evaluierungsinstitut der Entwicklungszusammenarbeit)
DIE	Deutsches Institut für Entwicklungspolitik
DRR	Disaster Risk Reduction
EWE	Extreme Weather Event
ExCom	Executive Committee of the Warsaw International Mechanism
GAR	Global Assessment Report
GIZ	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH
GMSL	Global Mean Sea Level
GP L&D	Global Programme on Risk Assessment and Management for Adaptation to Climate Change (Loss and Damage)
IIASA	International Institute for Applied Systems Analysis
IPCC	Intergovernmental Panel on Climate Change
MGNREGA	Mahatma Gandhi National Rural Employment Guarantee Act
NELD	Non-Economic Loss and Damage
OECD	Organisation for Economic Cooperation and Development
RCP 2.6	Representative Concentration Pathway 2.6
RCP 8.5	Representative Concentration Pathway 8.5 (IPCC scenario without climate action)
RCCI	Regional Climate Change Index
SDGs	Sustainable Development Goals
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

Executive Summary

Climate change and the increasing risks it poses to lives and livelihoods require targeted and integrated **climate risk management** (CRM), especially in vulnerable countries. While extreme weather events (EWE) have been given due prominence in risk management, **slow-onset processes** (SOP) such as sea level rise or desertification have been less well considered. Such processes unfold gradually and occur at widely different spatial scales, and shifts in their intensity, duration, and frequency can be triggered or amplified by climate change.

This working paper lays out **definitions, key challenges, and opportunities** for understanding risk and generating resilience to SOP (and related EWE). It describes a **CRM framework** developed for this purpose, and it sets out key areas for collaboration across research and development cooperation. CRM is comprehensive, integrative, and iterative by design. It can be used to help understand, assess, reduce, and/or address the diversity of risks posed by climate change, especially when planning or sustaining development progress.

Climate risk assessment builds a foundation for effective and forward-looking CRM. Assessing the impacts of SOP, however, is challenging. Not only are the impacts slow, spatially dispersed, and less perceptible than those of EWE, they are often indirect and result from interaction with other anthropogenic drivers, other SOP, or EWE. This requires a structured, needs-driven combination of methodological approaches and a systemic risk perspective to study interdependencies in risk drivers, exposure, and vulnerability across space and time. **Participatory approaches** and the **qualitative use of impact chains** should be complemented by **quantitative elements** such as risk indexes and scenario-based biophysical and economic modelling.

The best approach to effectively avert, minimise, and address losses and damages resulting from SOP will be an **integrative mix of CRM measures**. Climate change adaptation and disaster risk reduction measures can be combined to confront the risks arising from SOP and EWE interactions. Risk finance or transformational approaches can address residual losses and damages that cannot be further averted or minimised. CRM should also entail due attention to **non-economic losses from SOP**, including losses to cultural heritage. Policy and governance have vital roles when it comes to making decisions related to the already observable impacts and future risks of SOP, yet much more published evidence on acceptable and effective risk management is needed to inform stakeholders and decision makers.

The **CRM framework** created by GIZ in cooperation with IIASA and partner organizations proposes that knowledge and capacity gaps can be addressed through **multi-stakeholder dialogue and awareness raising (risk communication), mainstreaming, and learning**. The iterative design aims to help decision makers take account of growing evidence and insights, newly available data, and lessons learnt from monitoring and evaluation of measures. The CRM framework also incorporates integrative participatory processes to co-assess risks and risk perceptions and co-design options, leading towards a more just, effective, and sustainable CRM strategy.

The most pressing area for action is the **evaluation of CRM strategies** to derive evidence and advance the portfolio of approaches for SOP-related risks. This will require enhanced collaboration between development cooperation and research. These actors can also lead the way in fostering dialogue, awareness raising, and agenda-setting to better understand, anticipate, and eventually manage risks from both SOP and EWE. Such collaboration will help ensure that the implications for vulnerable communities and countries around the world are minimised and help contribute to the achievement of joint international goals and agendas, such as those set out in the Paris Agreement, Sendai Framework, and 2030 Agenda.


ÉVALUATION DES RISQUES
PRISE DE DÉCISION ET MISE EN ŒUVRE
apprendre
identifier les risques
évaluer l'ampleur des impacts
identifier les mesures
suivre et évaluer
mettre en œuvre
prioriser et financer les mesures
GRC
Gestion intégrée des risques climatiques
Comment est-ce qu'on va répondre ?
MESURES GRC
éviter, réduire et remédier aux pertes et préjudices
atténuation et développement durable à l'échelle mondiale
adaptation aux changements climatiques & réduction des risques de catastrophe
financement des risques et assurances & approaches transformatrices
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ÉVALUATION DES RISQUES CLIMATIQUES
L'évaluation des risques climatiques jette les bases d'une GRC réussie. En identifiant les risques et en évaluant l'ampleur des impacts sur les personnes, les biens et les écosystèmes, la GRC montre les options d'action possibles et répond à la question : Comment est-ce qu'on pourrait répondre ?
RISQUES CLIMATIQUES - MESURES DE GESTION

1. The need to consider slow-onset processes as part of climate risk management

People depend on healthy environments for their lives, livelihoods and economies. Such environments, including terrestrial, coastal and marine ecosystems, are predicted to be increasingly exposed to the effects of climate change over the course of this century. With the environments and ecosystems, entire communities and their assets are put at risk by **gradual climate change effects**, like desertification, glacial retreat or rising temperatures.

A commonly known example is the rise of global sea levels that will affect millions of people directly and indirectly. Impacts such as the salinisation of coastal soil and decreased fresh water availability could eventually lead to severe damage to, and loss of, livelihoods, ecosystems, and economic performance. Another example are the effects that desertification is expected to have due to reduced crop and livestock productivity or the biodiversity loss of ecosystems *(IPCC, 2019b)*. These examples show how climate change has taken on a new dimension, with the impacts on all continents and in natural systems becoming increasingly severe and evident. Emerging evidence suggests that natural systems are reaching the limits of their capacity to adapt, and that, depending on the specific context, so too are some social systems *(Mechler et al., 2020)*.

To deal with climate-related risks in a holistic manner, a **climate risk management (CRM)** approach has been proposed that is both comprehensive and iterative by design. Its objective is to understand, assess, reduce and/or address the diversity of risks posed by climate change through risk management, especially in planning and sustainable development processes. This approach is gaining traction in research, practice, and policy. However, while guidelines and risk management approaches are receiving increasing attention within international cooperation, at national levels and in policy discourse *(GIZ, IIASA & NIDM, 2019)*, the hazards that are being considered are primarily extreme weather events (EWE). Slow-onset hazards and processes are in many cases being overlooked.

This working paper emphasises that better integration of EWE and SOP is both essential and feasible for effective, forward-looking CRM. Comprehensive management of climate-related risks, including those triggered by SOP, at all levels is paramount, especially in the context of international cooperation, to increase resilience within particularly vulnerable regions and communities. While research is providing important scientific insight, actions and solutions need to be identified and implemented through country-driven and international programmes as well as development cooperation. Collaboration between research and development cooperation can be guided by a risk analysis approach.

The **Global Programme on Risk Assessment and Management for Adaptation to Climate Change (Loss and Damage)** (referred to in this paper as GIZ GP L&D), in cooperation with the **International Institute for Applied Systems Analysis (IIASA)** and other **partner organizations**, has developed a CRM framework that takes a risk-based and iterative approach to assessing and managing climate-related risks. It considers social, economic, non-economic, institutional, biophysical, and environmental aspects, and targets the interdependencies between SOP and EWE as amplified by climate change. The framework guides users towards identifying and selecting a set of suitable CRM measures. In this way, it enables timely and context-specific action to establish new or enhance existing management strategies for dealing with climate-related extreme events and for strengthening overall resilience, including to SOP.

Building on a workshop held with stakeholders from academia, research, civil society organizations and development cooperation in 2020, this working paper elaborates on the need to increasingly consider SOP in the context of climate risk assessment (CRA) and management, and discusses how risks associated with SOP can be further integrated into CRA as well as how CRM measures can be identified to effectively address SOP. It highlights how CRM frameworks can be equipped to factor in risks related to SOP, identifies remaining challenges that need to be overcome, and presents opportunities for applying a comprehensive approach to foster resilience to climate change. Finally, it suggests some areas for collaboration across research and development cooperation on the path towards strengthened climate resilience that better factors in risks linked to SOP.

2. SOP: a growing challenge for sustainable development and resilience to climate change

Climate projections anticipate a significant increase in the frequency, intensity, and duration of some SOP, such as rising sea levels and desertification *(IPCC, 2018, 2019a, b, 2021)*. Considered to be a consequence of climate change, these processes contribute to the growing challenges facing all countries in achieving their development aspirations, such as those defined by the Sustainable Development Goals (SDGs). However, they are particularly dramatic for developing countries and emerging economies where development achievements are being put at risk. In its Special Report on the impacts of global warming, the Intergovernmental Panel on Climate Change (IPCC) stated that even if global warming is kept to 1.5° C, the residual risks and potential losses and damages from slow-onset (as well as sudden-onset) processes will remain, with long-term implications for poverty, health, and human security *(IPCC, 2018)*. While further global warming will modify the hazards and their associated processes, the risks these pose and the scope of their impact will be determined by the interactions between risk, vulnerability and exposure.

2.1 Conceptualisation of SOP

The various adverse impacts of climate-related hazards can be grouped into sudden / rapid-onset and slow-onset events according to the time scale over which they evolve *(Huggel et al., 2019)*. Siegele *(2012)* characterises a **rapid-onset event** as a single event occurring in a matter of days or hours, while a **slow-onset hazard** gradually evolves from incremental change occurring over many years, or as an increased frequency or intensity of recurring events. In this paper, rapid-onset events are referred to as **extreme weather events (EWE)**, as this term is commonly used in the climate context. While EWE can have dramatic impacts in a relatively short time, slow-onset events lead to long-term changes in natural as well as human economic and social systems, and carry the risk of exceeding irreversible tipping points; for example, the release of additional greenhouse gases due to thawing permafrost soils.

Based on their characteristics, there is ongoing discussion around appropriate terminology for slow-onset events when considered in original research as well as in IPCC assessments. The term *slow-onset* ***events*** (SOE) is increasingly considered inaccurate since phenomena such as desertification or the loss of biodiversity are *gradual changes* rather than *events* that have a discrete beginning and end *(van der Geest & van den Berg, 2021)*.

> **"SLOW ONSET EVENTS,** as initially introduced by the Cancun Agreement (COP16), refer to the risks and impacts associated with: increasing temperatures; desertification; loss of biodiversity; land and forest degradation; glacial retreat and related impacts; ocean acidification; sea level rise; and salinization."
> (UNFCCC, 2018)

Figure 1: Categories of slow onset processes (UNFCCC, 2018).

In this paper, the term **slow-onset processes (SOP)** is used, and understood to include 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.**

Additionally, it is important to note that some events hold **aspects of both EWE and SOP**. An example would be droughts, which are defined as natural phenomena that exist when precipitation falls below normal recorded levels, but the considered duration of a drought will vary according to the impacts that are of interest. Risk and certain impacts will evolve in combination with specific exposure and vulnerability factors.[1]

WORKSHOP INSIGHT

Increasing relevance of SOP in IPCC reports

A recent journal article, published in *Current Opinion in Environmental Sustainability*, reviewed the evidence on SOP presented in the IPCC's Special Report on Climate Change and Land (SRCCL) and Special Report on the Ocean and Cryosphere in a Changing Climate (SROCC), both published in 2019 *(van der Geest & van den Berg, 2021)*. It analysed how the reports, and recent research cited in them, dealt with the eight types of SOP identified by the UNFCCC.

The authors used qualitative data analysis software to analyse the reports, and for each SOP they coded and analysed information about the current state, rate of change, timescale, geography, drivers, impacts, management responses, adaptation limits, and residual losses and damages. They showed that the SRCCL and SROCC pay most attention to temperature increases, land and forest degradation, sea level rise, desertification and glacial retreat, while ocean acidification, salinisation, and biodiversity loss receive less attention. Importantly, they found that the IPCC special reports primarily discuss the nature, drivers, and impacts of SOP, while significantly less attention is paid to management responses, including adaptation.

To inform policy and action on climate change and its impacts, research evaluating the effectiveness of different management options is essential. There is even less information available about limits and constraints to adaptation, and residual losses and damages resulting from SOP as the IPCC acknowledges: 'More work is required to explore the range of activities available for responding to losses and damages resulting from slow-onset processes' (SROCC: 630). It is now up to the research community and funding agencies to take up this important work.

**Contributed by Kees van der Geest, UNU-EHS.*

1 Further details on individual SOP and their associated processes is discussed in van der Geest & van den Berg (2021).

2.2
SOP: a challenge for resilience and sustainable development

While uncertainty remains in both the exact projection of most climatic hazards and the dynamic development of the associated risk drivers exposure and vulnerability, the impacts of climate change are already being felt in many parts of the world.

Research shows that SOP are becoming manifest with increasing frequency and magnitude, and to varying degrees across regions. The highest increases in temperature for the hottest days are projected for mid-latitude and semi-arid regions, as well as the South American Monsoon region. Regional sea level rise over the last few years has been highest in the Western Pacific *(IPCC, 2021)*. The magnitude of impact depends on future mitigation and adaptation pathways, but losses and damage are already inevitable for some SOP. Stopping sea level rise at its current level, or even slowing it down, for instance, will not be possible under current emission levels; indeed sea level rise will most likely increase until the end of this century and over centuries to come *(IPCC, 2019a, 2021)*. There is robust scientific evidence that impacts in any climate change scenario will increase if insufficient adaptation and risk management are implemented.

Communities that are dependent on ecosystems and their services, as well as those living in low-lying coastal zones, high latitudes or tropical regions, are predicted to be affected disproportionally *(IPCC, 2019a)*. Over time, economic and non-economic losses will increase as climate change impacts affect infrastructure and increasing numbers of people, slowing economic growth, making poverty reduction more difficult, and weakening food security *(IPCC, 2014)*. There is also evidence that SOP will have

PROCESS:

SEA LEVEL RISE

PROBABILITY OF OCCURRENCE

- In the 20th century, global mean sea level (GMSL) rose faster than in any prior century over the last three millennia (high confidence), with a 0.20 m rise between 1901 and 2018 (high confidence).
- Since the late 1960s, GMSL rise has accelerated with an average rate of 2.3 mm yr-1 over the period 1971 – 2018, further increasing to 3.7 mm yr-1 over the period 2006 – 2018 (high confidence).
- It is virtually certain that global mean sea level will continue to rise throughout the 21st century.
- By 2050, GMSL will rise by 0.18 m under the very low emissions scenario (SSP1 – 1.9) to 0.23 m under the very high emissions scenario (SSP5 – 8.5), resulting in a further ascent by 0.38 m (SSP1 – 1.9) to 0.77 m (SSP5 – 8.5) by 2100.
- Beyond 2100, GMSL will continue to rise for centuries due to continuing deep ocean heat uptake and mass loss of the Greenland and Antarctic Ice Sheets, and will remain elevated for thousands of years (high confidence).

CONSEQUENCES

Inundation and erosion, salinisation of soils and aquifers, worsening of coastal storm surges, loss of habitats and migration of species, damage to and loss of coastal infrastructure and territory.

Source: IPCC, 2021

PROCESS:

LAND AND FOREST DEGRADATION

PROBABILITY OF OCCURRENCE

- Climate change can lead to land degradation or further exacerbate human-induced land degradation, particularly in low-lying coastal areas, river deltas, drylands, and permafrost areas (high confidence) (IPCC, 2019b).
- Some regions may experience increases in land degradation through higher soil erosion rates and enhanced distribution competitiveness of agronomically important and invasive weeds (medium confidence) (IPCC, 2017).
- Sustained increases of as little as 1° C in mean annual air temperature can be sufficient to cause changes in the growth and regeneration capacity of many tree species. In several regions, this can significantly alter the function and composition of forests; in others, it can cause forest cover to disappear completely (medium confidence) (IPCC, 1996).

CONSEQUENCES

Loss of soil fertility, soil erosion, nutrient depletion, reduction in vegetation cover, loss of biodiversity, loss of livelihoods due to decreasing yield potential. Secondary consequences: water and food insecurity, increasing conflict implications, and, in drylands, desertification.

Source: IPCC, 1996, IPCC, 2017 and IPCC, 2019b

PROCESS:
GLACIAL RETREAT AND GLACIAL LAKE OUTBURST FLOODS

PROBABILITY OF OCCURRENCE

- Glaciers lost an estimated 6,200 Gt of mass over the period 1993 – 2019 and will continue losing mass for decades or centuries under all SSP scenarios (very high confidence) (IPCC, forthcoming).
- During the decade 2010 – 2019, glaciers lost more mass than in any other decade since the beginning of the observational record (very high confidence) (IPCC, forthcoming).
- Due to their lagged response, glaciers will continue to lose mass at least for several decades even if global temperature is stabilized (very high confidence) (IPCC, 2021). Glaciers will lose an estimated 29,000 Gt and 58,000 Gt over the period 2015 – 2100 for RCP2.6 and RCP8.5, respectively (medium confidence), which represents 18 % and 36 % of their early-21st-century mass, respectively (IPCC, forthcoming).

CONSEQUENCES

Locally: erosion, mudslides, flooding and the formation of meltwater lakes with potential for glacial lake outburst floods (see the Peruvian example presented as a Workshop insight: Glacier shrinkage in Peru).

Globally: rising sea levels.

Source: IPCC, 2021 and IPCC (forthcoming)

potentially severe impacts on livelihoods, human health, cultural and natural heritage, productivity of systems, among others *(see, for example, Aleksandrova & Costella, 2021; Simpson et al., 2021)*.

Most regions in the world experience **cascading effects** as EWE and SOP interact. Various interdependencies exist between distinct events and processes and some climate-related risks are becoming increasingly **compound** (with interactions between multiple hazards and societal drivers) as well as **systemic** (with interdependent hazards across space and time). The **cascading risks** of SOP can be seen in changes in, for example, sea levels or degrading soils, which have multiple consequences such as population displacement or food insecurity *(Schäfer et al., 2021)*. Furthermore, SOP can trigger additional hazardous impacts, such as coastal erosion, or saltwater intrusion *(IPCC, 2019b)*.

Given the serious current and expected future changes in natural systems, adaptation to climate change is essential and needs to be ramped up *(IPCC, 2018)*. Despite a general capacity to adapt to changes triggered by SOP, socio-ecological systems may face limits to their ability to adapt when dangerous thresholds in vital biophysical, sociocultural, or economic systems are crossed *(Dow et al., 2013; Klein et al. 2014; see also Workshop insight: Critical threshold values to assess SOP risks)*. There is increasing evidence that, under specific conditions, global and local ecological and social systems experience 'soft' and 'hard' limits to adaptive

WORKSHOP INSIGHT

Glacier shrinkage in Peru

The **interactions between EWE and SOP** have to be viewed with particular concern. As demonstrated by Huggel et al. *(2019)*, SOP need to be considered in terms of both their dynamic effects and their interactions. An illustrative example that was presented during the workshop is **glacier shrinkage in Peru**. Glacier shrinkage results in changed water resources (river runoff) affecting livelihoods, agriculture, and hydropower, but also contributes to the risk of glacial lake outburst floods affecting people's lives and assets as well as community infrastructure, with the potential to cause economic losses in exposed areas. The differences in emission levels as assessed through future RCP scenarios strongly impact the shrinkage of glaciers and hence the consequences. Likewise, different levels of warming have substantial negative but differentiated effects on natural and human systems. Consequently, the risks associated with glacial retreat must be treated comprehensively. There is growing pressure, but fewer possibilities, in terms of the time and action needed, to tackle increasing levels of warming.

capacity and adaptation *(Mechler et al., 2020; UNFCCC, 2018)*. Limits to adaptation determined by social, economic and cultural factors – sometimes termed 'soft adaptation limits' – can potentially be overcome and transformed *(Dow et al., 2013)*. 'Hard adaptation limits', on the other hand, arise when a system cannot adjust to new climate regimes, leading to unavoidable and potentially irreversible impacts *(IPCC, 2014; Roy et al., 2018)*. Such hard limits are evident particularly for natural systems. Corals constitute a prominent example as reefs have been degrading since the late 1990s. According to the IPCC's SROCC *(2019)*, warm-water corals especially are already at high risk and such systems may reach the limits of their ability to adapt.

2.3 SOP in international policy agendas

SOP in the UNFCCC context

For climate risk policy and governance at local through to international levels, understanding SOP and their consequences, and the integration of EWE and SOP across and within sectors and planning, is paramount. Although sea level rise and its impacts have been at the forefront of scientific and policy debates, such as that led by the Alliance of Small Island States (AOSIS) at the founding negotiations of the UNFCCC in 1992, in recent processes and agendas, SOP have not always been centre stage. With advances in

INFOBOX

SOP in the Loss and Damage sphere and under the WIM

With the Bali Action Plan 2007 and the Cancun Adaptation Framework at COP 16 in 2010, the issue of losses and damages became a topic for debate. At COP 19 in 2013, the WIM was established to govern actions to avert, minimise, and address losses and damages. The WIM builds on the UNFCCC mechanism mandated to address SOP. Its official mandate 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)*. Therefore, the WIM, and in particular its guiding Executive Committee (ExCom), aims to enhance understanding of comprehensive (climate) risk management and foster dialogue and collaboration between relevant stakeholders. The current five-year rolling work plan of the WIM ExCom was endorsed in 2017 and includes **slow-onset events** as one of five strategic workstreams.[2]

As part of the WIM work plan and the work on SOP in particular, a technical expert group has been established on the topic of SOP (TEG-SOE). In the TEG-SOE, knowledge creation, which was one pillar of the ExCom's initial two-year work plan, is being developed further. Recommendations on the integration of losses and damages from SOP into national planning and policy making, and on capacities to address SOP, are also being developed. As one of the activities under the TEG-SOE's plan of action, the research community has been invited to contribute to a special issue of the journal *Current Opinion in Environmental Sustainability*[3] which will consider *Slow-Onset Events related to Climate Change* and will cover SOP such as sea level rise and subsidence, water insecurity, heat, glacial retreat, and salinisation, among others. It will also discuss risk management and policy, including social protection, finance, and support for human mobility.

During the workshop, one of the TEG-SOE's co-champions highlighted the importance of expert knowledge on specific topics for CRM strategies and also for political action. Further advancing the understanding of SOP and their potential impacts are among the key objectives of the TEG-SOE's rolling plan of action.

During COP26, the TEG-SOE re-emphasized that enhancing the understanding and capacities for dealing with SO(E) is the TEG's main objective. In addition, a call for submissions on innovative policy solutions on SOE was conducted this year, the submissions are currently under review.

2 5yr_rolling_workplan.pdf (unfccc.int)

3 https://www.sciencedirect.com/journal/current-opinion-in-environmental-sustainability/vol/50/suppl/C

research, this is changing, and in the climate policy fields of adaptation and Loss and Damage, SOP are now receiving increasing attention.

In their post-2015 agenda, the Paris Agreement signatories reaffirmed the mandate of the **Warsaw International Mechanism for Loss and Damage associated with climate change impacts (WIM)**, and stated in Article 8 that all Parties of the Convention face the challenge of developing and implementing concrete and effective comprehensive (climate) risk assessment and management instruments and measures to avert, minimise, and effectively address losses and damages caused by climate-related extreme events and slow-onset changes. Under Article 8 of the Paris Agreement, paragraph 4 states SOP to be one of eight specific areas of cooperation and facilitation.

SOP in the UNDRR context

For the **United Nations Office for Disaster Risk Reduction** (UNDRR, formerly UNISDR) the understanding of disaster risk has transitioned from considering mainly rapid-onset hazards towards a broader conceptualisation integrating SOP. This development is reflected in the biennial UNDRR Global Assessment Reports (GARs) (see, for example, the recent UNDRR report on drought *[UNDRR, 2021])* as well as in the Sendai Framework for Disaster Risk Reduction 2015–2030 *(UNISDR, 2015)*. While single SOP such as droughts, sea level rise, or glacial shrinking were mentioned in earlier reports, it was only in the GAR of 2015 that SOP were first referred to as a separate category (with the terms 'slow-onset hazard' and 'creeping changes'). They were further considered in the context of human mobility in the 2019 GAR *(UNDRR 2019)*.

The **Sendai Framework** is guiding current disaster risk reduction (DRR) efforts. In contrast to previous frameworks, the Sendai Framework's conceptualisation of disaster explicitly includes SOP. However, monitoring of the framework's implementation is not comprehensive. Sendai indicators might not yet cover SOP impact data sufficiently *(Zaidi, 2018)*, for example sea level rise is not explicitely included as category in the DesInventar database *(Gall, 2015)*.

Alongside the Paris Agreement and the Sendai Framework, the **UN's 2030 Agenda and its SDGs** are also crucial when considering SOP. While SOP have the potential to undermine development achievements, conversely, the achievement of several SDGs appears fundamental to increasing capacity and strengthening resilience to cope with SOP. Therefore, there are evident synergies between the SDGs and enhancing resilience towards SOP. Further reflections on the coherence between the SDGs and CRM will be included in a forthcoming study by GIZ GP L&D.


Glaciar in Ladakh in the indian Himalaya, 5,000 m above sea levels

3. Key opportunities and challenges when considering SOP in an integrated CRM framework

The predicted increased severity and frequency of the impacts of SOP and EWE, and the interactions between them, on livelihoods, ecosystems, and economic performance means more attention must be paid to SOP within CRM and Loss and Damage discussions. It is necessary to understand and address all climate-related risks holistically. In response, **the GIZ GP L&D in cooperation with IIASA and partner organizations** has developed **an integrated, comprehensive, and risk-based CRM framework** (Figure 2)[4] that supports the management of potential losses and damages. The CRM framework is an iterative management cycle comprising sequential steps and considers the entire spectrum of climate-related hazards and impacts from EWE through to SOP. It takes account of the interdependencies between EWE and SOP, acknowledging that the latter can cause the former (for example, sea level rise can result in a storm surge), and that both can occur at the same time. The following discussion considers how the CRM framework can foster resilience towards SOP, and the challenges and areas for action that have been identified by research and development practitioners. Three elements that are central to CRM will be considered in terms of opportunities and challenges for enhancing resilience towards SOP: **(1) CRA; (2) identification of CRM options; and (3) decision-making and governance in the context of SOP.**

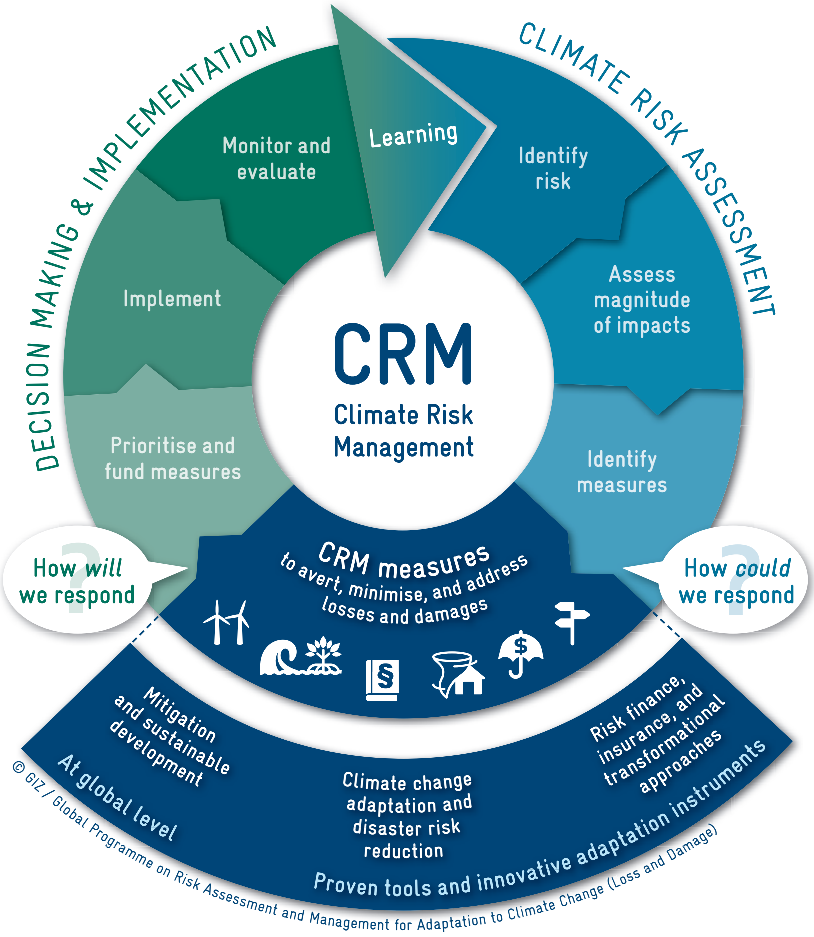

Figure 2: CRM framework. © GIZ/Global Programme on Risk Assessment and Management for Adaptation to Climate Change (Loss and Damage)

4 For general information on the CRM framework, please refer to this Infosheet

3.1 Assessing SOP risks in Climate Risk Assessment (CRA)

CRA builds the foundation for successful CRM. CRA assesses risks by analysing one or more determinants of risk (hazard, exposure, and vulnerability) and their interactions. Suitable solutions are proposed based on the identification of the magnitude of impacts on people, assets, settlements, infrastructure, industries, value chains, and ecosystems now and in the future. In this way, decision makers from the public and private sectors, along with other stakeholders, are supported in forward-looking planning.

GIZ GP L&D, IIASA and other partners have developed a 6-step methodology for CRA (Figure 3)[5]. This methodology involves stakeholder participation, addresses the entire spectrum of hazards, considers interdependencies between risks and adaptation limits, and aims to identify a smart mix of management options. It represents the first step of the CRM cycle, where CRA leads to the prioritisation of measures, decision-making and implementation, learning, and iteration. An example of how the methodology is applied is described in the **Infobox** ***How GIZ's 6-step CRA methodology accounts for SOP – the example of salinisation in Tamil Nadu in India***.

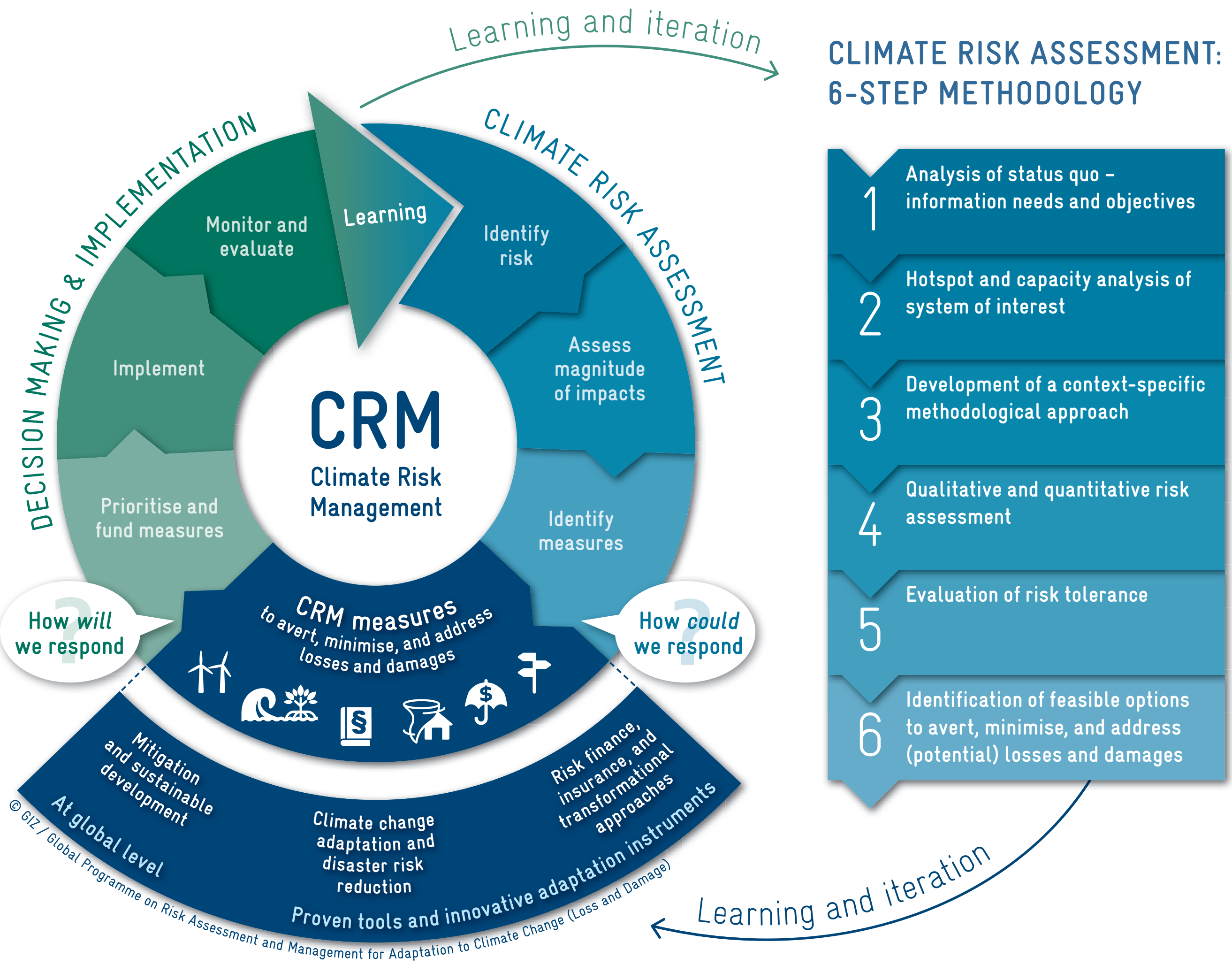

Figure 3: The 6-Step Methodology of Climate Risk Assessment as part of the CRM framework. (Source: GIZ, 2021).

5 See "Assessment of climate-related risks. A 6-step methodology" for further information on the methodology

INFOBOX

How GIZ's 6-step CRA methodology accounts for SOP – the example of salinisation in Tamil Nadu in India

The 6-step CRA methodology has been piloted in Tanzania and India. In Tamil Nadu in 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. A comprehensive CRA 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 (described in the box *Workshop insight: SOP and compound and systemic risk*) and desktop analysis including inventories of observed and modelled losses and damages.

In the field surveys, more than 95 % of households reported that salinisation was adversely affecting agriculture and that its impact was increasing. Also, 88 % of respondents said salinisation impaired drinking water quality, and many mentioned health, livestock, and fishery impacts (80 %, 71 %, 49 %, respectively). To assess the magnitude of these impacts, a quantitative assessment of losses and damages arising through salinisation was conducted. As no comprehensive database on the extent of salinisation was available, the CRA used data provided in India's wasteland atlas for 2005 and 2010, which recorded the land affected by salinity and alkalinity at the district level. Based on observations during the field surveys, it was assumed that the yield of the paddy crop in the area affected by salinity was around 50 % less than that of similar rice cultivars grown in the unaffected area. The results indicated that a total loss of about 77,000 tons of rice production could be attributed to salinisation in Tamil Nadu, which represents about 2 % of the total rice production in the state. As evidenced through the field survey, coastal districts were bearing more losses than non-coastal districts and, in both districts surveyed, farmers were responding by leaving land uncultivated.

(Source: Adelphi & GIZ, 2015; GIZ, IIASA, NIDM India, 2019)

Assessing SOP-related risks is challenging and SOP are insufficiently considered in most CRA approaches. A study conducted by GIZ GP L&D found that fewer than half of a sample of 120 CRA methods applied to SOP and considered the entire spectrum of climate hazards triggering risk (GIZ GP L&D, forthcoming). Therefore, **innovative approaches** are needed to adequately assess the risks of SOP in CRAs.

One challenge for assessing the risks arising from SOP is the **indirect causation of impacts**. SOP often cause limited direct impacts but trigger large ripple effects with significant indirect losses and macroeconomic effects *(Gall, 2015)*. For communities with low adaptive capacities, direct, but especially indirect, effects can bring about severe consequences (see the box *Workshop insight: SOP and compound and systemic risks*).

The losses and damages resulting from SOP often manifest more slowly than those arising from EWE and frequently depend on their interaction with anthropogenic drivers (for example, salinisation as a result of mismanagement of soils combined with less precipitation), other SOP or EWE. As most EWE are already impacted by SOP, this leads to difficulties in attributing causal relationships to either EWE or SOP. The distinction between EWE and SOP is somewhat artificial as temporal and spatial scales overlap, and adverse consequences are interlinked.

Assessing SOP therefore requires a **systemic risk perspective** through considering, for example, **impact chains** (see the impact chains section in the box *Workshop insight: SOP and compound and systemic risk*). A key aspect of using impact chains is to translate SOP into more specific hazard-impact types that cause evident damages. For example, the impacts of sea level rise can be translated into hazard-impacts such as coastal erosion, saltwater intrusion, and coastal flooding *(Gall, 2015)*. Based on such initial

WORKSHOP INSIGHT

Compound and systemic risk in the context of SOP*

One illustrative example of risk imposed by **compounding SOP and EWE-related hazards**[1] on the livelihoods of coastal and small island communities is sea level rise combined with higher wave run-up, increasing aridity, and decreasing freshwater availability due to saltwater intrusion. If coastal defences, ecosystem-based adaptation and reef restoration do not work effectively to buffer against worsening risks, the current 'soft' limits to adaptation are projected to translate into a 'hard' limit if freshwater supply and coastal protection fail completely in the face of compounding events. This will eventually render small atoll islands uninhabitable, and has already been projected for some islands to occur at about 2°C of warming *(IPCC, 2018; Deubelli and Mechler, 2021)*.

Systemic risk refers to potential impacts in networked socio-ecological systems, where an initial impact leads to a cascade of follow-on adverse effects, affecting system functions and possibly leading to system collapse *(Hochrainer-Stigler et al., 2018)*. As an example, the loss of infrastructure and crops as a consequence of compounding droughts and floods in Mozambique in the mid-2000s has been found to have had a substantial adverse domino effect on key socio-economic outcomes such as housing, jobs, education levels, and social cohesion. To rebuild and recover from such events, households often adopt asset-depleting strategies, including selling homes and productive capital, or taking children out of school to earn an income, which can lead to a long-term drawdown of human capital, eventually affecting income and well-being of those impacted *(Reichstein et al., 2021)*.

Impact chains

In the initial stages of CRA, stakeholders are generally interested in understanding the scope of impacts within and across systems. The use of impact chains has been highlighted as useful when assessing climate risks related to SOP. An impact chain describes the cause and effect relationships between different elements of a system to help clarify the potential consequences. It constitutes 'an analytical tool that helps you better understand, systemise, and prioritise the factors that drive vulnerability in the system under review' *(GIZ Vulnerability Sourcebook, 2014, p. 58)*. Impact chains are a powerful tool for enhancing understanding and transparency, as they determine the interdependencies between all risk components (hazard, vulnerability, and exposure) and demonstrate how biophysical and socio-economic factors interplay. Cultural and ecological factors, which are of great importance for non-economic valuation, are equally visible. The use of participatory methods such as workshops involving key institutions and experts, as well as representatives of affected sectors or communities, for co-creating impact chains can help to broaden knowledge, create a common concept, and encourage ownership.

**Based on workshop contributions by Thomas Schinko (IIASA), Marc Zebisch (Eurac), and the GIZ GP L&D in October 2020.*

1 Definition of compound risk: multiple hazards and societal drivers are interacting.

assessment, **participatory approaches** can then be applied to explore local perspectives of the risks of an SOP through qualitative interviews, focus groups or household surveys. Bennett et al. *(2015)*, for example, use interviews to assess local perceptions of specific exposures to SOP such as sea level rise, ocean acidification, and loss of marine biodiversity and EWE such as tropical storms and, based on this, rank the exposures of communities, households, or certain groups on a scale from 1–5.

Another commonly encountered challenge when capturing the impacts and risks of SOP is the **limited time frame** of most risk assessments. While EWE may last for a definable time span and occur in an identifiable spatial extent, the impacts of SOP generally accrue gradually over time and occur in a spatially dispersed manner. This challenge is exacerbated by difficulties with data availability. Models that accurately capture long-term gradual changes often require data at long timescales, which are not available for all types of SOP and for all countries *(Huggel et al., 2016)*.

Index development or index use is one possible solution to address issues linked to the limited time frame of CRAs. Through index development, **critical threshold values** for certain timescales and spatial extents are adopted in accordance with the needs of the system of interest. As an example, Torres et al. *(2012)* use the Regional Climate Change Index (RCCI), which calculates changes in mean temperature and precipitation as well as precipitation variability for certain regions. Historical data sets can also be used to consider long-term changes. Binita et al. *(2015)*, for instance, use variation in decadal mean temperature and precipitation data to analyse long-term climate risks. Eventually, critical thresholds could be linked to risk tolerance levels (see the box *Workshop insight: Critical threshold values to assess SOP risks*).

More attention must be focused on **determining the long-term impacts** of SOP in CRAs. For example, salinisation due to sea level rise not only affects soils and thus planted crops, but also future harvests. Such losses persist over months, years, or even decades and centuries. Soil degradation, food insecurity, and the abandonment of land may result. Against this long-term perspective, CRAs need to specify the time span of the indirect losses considered. Ongoing review and updating of SOP-related CRAs is also required *(Gall, 2015)*.

Scenario modelling can account for future risks. Preston et al. *(2007)*, for example, base their investigations on quantitative scenarios of climate change, including projections of changes in average temperature, rainfall, evaporation, and humidity in 2030 and 2070. Herron et al. *(2016)* use pertinent climate data to construct specific hazard models,

WORKSHOP INSIGHT

Critical threshold values to assess SOP risks*

The determination of critical threshold values specific to a target system was proposed during the workshop as a means of addressing challenges connected to the definition and time frames of SOP. The determination of quantitative thresholds transforms a SOP, for example sea level rise, into an event that 'strikes' once the threshold is exceeded. In this way, spatial extent and timescale are adapted to the needs of the target system. Critical thresholds could be linked to a risk tolerance level based on the subjective risk preference of specific agents (households, private and public sectors). What eventually constitutes acceptable, tolerable, and intolerable risk is strongly determined by social, cultural, and economic factors, and often requires joint subjective and expert judgement. Novel participatory research methods (for example, formative scenario workshops and/or role play simulations) need to be developed and applied to facilitate engagement with potentially affected actors with regard to their subjective risk perceptions, and to co-design threshold scenarios in a participatory manner.

**Based on workshop contributions by Thomas Schinko (IIASA), Marc Zebisch (Eurac), and the GIZ GP L&D in October 2020.*

which include sea level rise and its interaction with other hazards as the main relevant SOP.

A mixed-methods approach **combining different methods for gathering** qualitative and quantitative data is therefore the best way to factor in and assess the risks arising from SOP. Participatory approaches (e.g. social simulations or focus group consultations) and qualitative social science methods (e.g. semi-structured expert interviews) should be complemented by quantitative elements, such as closed-ended surveys, index development or the use of existing indexes, and scenario modelling to account for the long time frame and less perceptible effects of SOP. The combination of climate data, especially on long-term trends and future projections, with local observation and knowledge can be a suitable approach to assessing climate risks arising from SOP.[6]

3.2 CRM measures to address impacts from SOP and foster resilience

While CRA is essential for identifying suitable CRM options in a given context, the **selection of the right mix of measures** is the key next step in effectively averting, minimising, and addressing losses and damages resulting from SOP. Stand-alone measures are not enough to respond to the manifold and creeping manifestations of SOP. Instead, to comprehensively manage direct triggers of SOP (for example, greenhouse gas emissions), as well as SOP themselves (for example, sea level rise) and their related impacts (for example, salinisation of land), an **integrated approach** using a wide range of measures must be employed. The interactions between SOP and EWE must also be considered when identifying a suitable mix.

The proposed **CRM framework integrates a broad portfolio of measures to avert, minimise, and address losses and damages**.

Averting losses and damages through mitigation and sustainable development

To **avert** the emergence of SOP and the resulting losses and damages, **measures to mitigate greenhouse gases and foster sustainable development** at the global level are paramount; for example, enabling access to renewable electricity and environmentally sustainable transportation or risk-informed land use and development plans.

Minimising losses and damages through CCA and DRR

To **minimise** losses and damages that cannot be (fully) avoided, proven and effective approaches from **Climate Change Adaptation (CCA) and DRR** (such as ecosystem-based adaptation, early warning systems and civil protection plans) can be combined to **confront increasing risks from the interaction of EWE and SOP**.

Addressing losses and damages through risk finance and transformational approaches

To **address** residual risks of losses and damages that cannot be averted or minimised, **innovative risk finance instruments or transformational approaches** may be required, given the long and uncertain time frame over which SOP manifest. Risk finance, for example through adaptive social protection (see below), provides complementary financial security against the loss of assets, livelihoods, and lives, or helps for instance to finance unavoidable relocation of settlements as described below. Transformational approaches include the diversification of livelihoods, behavioural change, flexible and participatory decision-making, and adaptive management approaches. However, transformation, especially of behaviours and livelihoods, is complex. An example of such an approach is human mobility: the support of voluntary migration can be a way of diversifying income sources and enabling alternative livelihoods. Planned relocation, usually considered a last resort, moves communities out of harm's way and is also a precautionary strategy to avoid the third form of climate-induced human mobility, displacement. This transformational approach is particularly relevant when low-lying islands or coastal areas become uninhabitable due to sea level rise, be it through complete submersion of the land, or salinisation of water resources or land as can be observed in Pacific Island countries like Fiji. There is a consensus that co-designing such transformational approaches together with affected stakeholders and communities is principal. After all, climate-induced human mobility can also mean leaving land behind which is crucial for culture, tradition and identity of many peoples.

6 Further information on a selection of CRA methodologies can also be found in the "CRA-Method Search Engine" (CRAMSE)

PROJECT PROFILE – SEA LEVEL RISE

Relocated community of Tukuraki, Fiji.

Human mobility in the context of climate change (HMCCC)

› WEBSITE

Implementation/ Funding	GIZ for German Federal Ministry for Economic Cooperation and Development (BMZ) and New Zealand Ministry of Foreign Affairs and Trade (MFAT)
Term	2017–2023
SOP	Sea level rise, desertification, coastal erosion, increasing temperatures, ecosystem loss and land degradation
Region/Countries	Caribbean, East Africa, Pacific, Philippines, West Africa
CRM Measure related to SOP	Concepts on voluntary and planned relocation, regional agreements to facilitate free movement

Comprehensively managing risks resulting from SOP must include a **special focus on non-economic losses**. In their analysis of a case study in Senegal, Schäfer et al. *(2021)* find that SOP cause greater non-economic losses and damages than economic ones. In the case study they present, sea level rise in Senegal is already threatening to destroy cultural heritage sites. Transformational approaches play an important role in addressing non-economic losses and damages.

Coastal erosion in Grenada

Integrated Climate Change Adaptation Strategies (ICCAS)

› WEBSITE

Implementation/ Funding	GIZ for German Federal Ministry for the Environment, Nature Conservation, Building and Nuclear Safety (BMU) within the scope of the International Climate Initiative (IKI)
Term	2013–2019
SOP	Sea level rise, salinisation of coastal soils, increasing temperatures
Region/Country	Grenada
CRM Measure related to SOP	Integrated water resource and coastal zone management including restoration and co-management of mangroves, rain water harvesting and climate smart agriculture, climate finance and knowledge management

One major challenge in choosing the appropriate mix of CRM measures lies in the **high degree of uncertainty surrounding the manifestations of SOP**. The long-term nature and slower manifestation of SOP impacts, together with the potential for ongoing change to accelerate at any time, result in uncertainty about definite risks and impacts from SOP *(Schäfer et al., 2021)* and their timing. This creates a **challenging starting point** for stakeholders aiming to select the most promising mix of CRM measures.

In response, the CRM framework is embedded in a **dynamic learning cycle**, allowing for decisions to be adjusted over time. The iterative design of the framework aims to enable decision makers to take account of mounting evidence and insights, newly available data, and lessons learnt from monitoring and evaluation of measures. The analysis can be repeated regularly to adapt measures accordingly and feed new information relevant to each individual step into the succeeding steps.

A second challenge raised by workshop participants was that of **achieving acceptance of CRM measures by the target group, and the financial support to implement them**. To accommodate this, the CRM framework encourages an **integrative participatory process** to co-assess risks and risk perceptions, and co-design options to address them. Especially transformational approaches need to be co-designed together with affected communities in a participatory and procedurally fair manner.

In addition, the framework takes account of the organisational and economic ability of countries, communities, and the private sector to adapt and respond to risk. These factors are important when identifying the right mix of measures to ensure climate-resilient development pathways. Context-specific and participatory CRM leads to a more just and effective CRM strategy, and enhances the suitability, acceptance, and sustainability of measures.

A third challenge noted by workshop participants lies in the **lack of reported evidence** on the effectiveness of CRM measures for SOP. Existing approaches primarily focus on managing the risks and impacts of EWE and there is little experience with approaches, particularly transformational approaches, that address potential losses and damages from SOP. In addition, many measures commonly used in the management of EWE are not applicable to SOP. For example, the paying out of emergency funds is often linked to a triggering event, something that is missing in SOP *(Matias, 2017)*. Risk pooling by insurance is a useful tool to deal with residual risks as part of an integrated CRM approach, but does not easily fit the case for SOP because risks are high and relatively certain.

An alternative risk finance scheme could be the application of **adaptive social protection (ASP)**. ASP refers to the integration of disaster risk management, climate change adaptation, and social protection into development processes (Figure 4). By integrating measures from all three domains, ASP aims to build the resilience of poor and vulnerable households in the face of multiple interacting risks, including from natural hazards, poverty, and climate change *(UNU-EHS, n.d.)*.

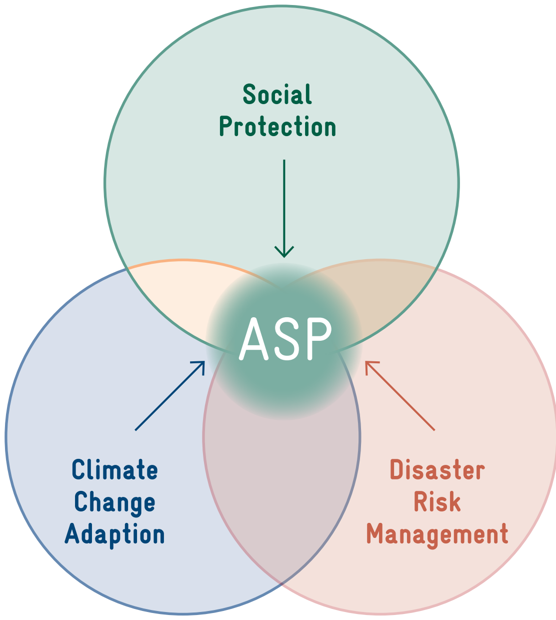

Figure 4: The concept of adaptive social protection (ASP). (Source: BMZ/GIZ, 2021).[7]

CRM measures relating to adaptation target the two determinants of vulnerability and exposure, but do not avert the emergence of SOP per se.

The CRM framework provides a practical starting point that allows stakeholders to **implement concrete (piloting) activities and projects to test the applicability and effectiveness of CRM measures to different SOP on the ground.** Thanks to the iterative design of the CRM framework, the evidence gathered can be integrated easily into the subsequent steps of a project and into follow-up projects.

7 For more information on ASP, refer to Adaptive Social Protection in the Sahel – Healthy Developments (bmz.de)

Kenya: Planting mucuna (velvet bean) increases soil fertility and counteracts soil erosion and weed development

Global Programme Soil Protection and Rehabilitation for Food Security, as part of the Special Initiative ONE WORLD – No Hunger

› WEBSITE

Implementation/ Funding	GIZ, on behalf of German Federal Ministry for Economic Cooperation and Development (BMZ) and with co-funding from the European Union (EU)
Term	2014 – 2025
SOP	Land and forest degradation, desertification, loss of biodiversity, increasing temperatures
Region/Countries	Benin, Burkina Faso, Ethiopia, India, Kenya, Madagascar, Tunisia
CRM Measure related to SOP	Implementation of sustainable land management, in particular soil protection and rehabilitation practices (SPR), including agroecological practices; Political, institutional and social anchoring of SPR, including integration in national political and legal frameworks and cooperation and involvement of the private sector; Transfer of lessons learned and innovations in SPR and capacity development; Piloting of soil protection for mitigation of and adaptation to climate change and for food security

PROJECT PROFILE – GLACIAL RETREAT

Strengthening of Livelihoods through Climate Change Adaptation in Kyrgyzstan and Tajikistan

› WEBSITE

Implementation/ Funding	GIZ for German Federal Ministry for Economic Cooperation and Development (BMZ)
Term	2014–2018
SOP	Glacial retreat
Region/Countries	Kyrgyzstan, Tajikistan
CRM Measure related to SOP	Adaptation measures in agriculture (water-saving irrigation methods, water-efficient crops, the use of quality seeds and the rehabilitation of water reservoirs); Construction of dams and riverbank reinforcement and erosion control

Enhanced collaboration and the timely exchange of learnings between development practitioners and researchers is crucial to advancing the portfolio of effective CRM measures. Piloting measures in the field can provide invaluable insights for research, while the analysis of newly available data is crucial to enhance measures on the ground. **Collaboration between research and development agencies should therefore be strengthened and expanded to better understand SOP, enhance existing approaches, and jointly develop new strategies to comprehensively and sustainably foster resilience towards SOP.** Further collaboration between the SOP and EWE research communities with respect to CRM is also desirable. Carrying out more participatory processes, with a focus on the longer term, so that SOP can be effectively addressed in development projects, is seen as a great advantage.

WORKSHOP INSIGHT

Further challenges and opportunities when managing climate-related SOP and resulting impacts

Challenges

The discussions at the workshop showed that there are **few practical examples of CRM projects related to SOP** and that many existing projects are still at an early implementation stage, particularly those involving transformative approaches. Projects also often have a short time span, which makes it difficult to address SOP. Also, available national and international financial resources are considered significantly below current and future projected needs for coping with climate risks.

Participants in the workshop also highlighted that the **two policy fields of DRR and CCA still mostly work in silos.** SOP are a cross-cutting topic and there are often interactions between EWE and SOP, yet the two disciplines work to different timescales and perspectives. This can be partly due to institutional reasons, including different responsibilities at national and international levels.

Opportunities

Participants agreed that across all measures and in the light of instrument-specific weaknesses and context-dependent challenges, **approaches and instruments need to be combined** with the objective of dealing more comprehensively with remaining risks. **Merging the DRR and CCA agendas under the umbrella of CRM** is considered an important step to bridge the gap and enhance a joint understanding of risk to tackle interactions between EWE and SOP.

In the face of increasingly severe and existential climate-related risks, analysts have emphasised the role of **transformational adaptation** in extending soft adaptation limits. While 'transformation' may often involve ex situ responses and moving away from the source of risk, 'transformational adaptation' has been defined as truly tackling the root causes of vulnerability through justice, equity, and poverty-centred approaches *(Roberts and Pelling, 2020)*. Actions focus on systemic change to address the root causes of risk, so that a breaching of limits is prevented or at least postponed. Transformational adaptation implies that 'business as usual', incremental risk management will no longer suffice because of the increasing potential for losses or exceedingly large uncertainty *(Deubelli and Mechler, 2021)*. A pertinent example is that of pervasive drought and heat in agriculture which, combined with other push and pull factors, is forcing farming households to transform their livelihoods towards non-farming income or completely abandon agriculture for employment in other sectors. Where planned transformation may not be possible, often relocation or displacement may occur *(de Coninck et al., 2018)*.

**Based on workshop contributions by Alexandra Köngeter and Gerald Leppert (DEval), Stefan Kienberger (University of Salzburg), Maryia Aleksandrova (DIE), Reinhard Mechler (IIASA) and the GIZ GP L&D in October 2020.*

3.3 Policy, governance, and practices in the context of SOP decision-making

At present, the interactions between SOP and EWE are not sufficiently reflected in CRM. However, the connectivity between various sectors affected by SOP means that **integration and coordination within and across sectors is paramount**. For instance, the consequences of floods and droughts on the agricultural sector can be devastating, threatening not only the economic development of countries but also the self-sufficiency of subsistence farmers; they can also lead to climate-induced migration or displacement. Various sectors and areas of policy and decision-making must work together to manage these risks through measures such as early warning systems, efficient irrigation schemes, or drought-sensitive crop diversification. Raising awareness and mainstreaming incentives and providing support for enhanced risk management must be put centre stage to achieve this.

Decision-making and governance that factor in SOP and interacting risks are challenging for several reasons. Political **decisions and resource allocation must be made under a high degree of uncertainty** *(compare OECD, 2021)*. Because SOP can be seen as disaster risks or as threats from climate change, it is often unclear which policy domains (DRR or CCA) ought to govern, with the result that responsibilities can be overlooked *(Schäfer et al., 2021)*. Also, there is a **lack of reported evidence from successful projects or good practices** that could be integrated into policy and replicated. Furthermore, Schäfer and Künzel *(2021)* found that **national financial mechanisms** are significantly less developed for SOP than for EWE. International support, including through funding, undoubtedly helps to sustain adequate national financial mechanisms, especially with regard to SOP.

To reduce knowledge barriers and uncertainties associated with decision-making on SOP, advanced tools and databases to **assess, record, and anticipate SOP-related losses and damages** are needed. Global disaster loss databases record losses and damages from numerous EWE, but cover SOP only to a very limited extent *(Zaidi, 2018)*. For example, DesInventar, the Sendai Framework's loss database, considers SOP only to a limited degree (e.g. the categories droughts, coastline changes, biodiversity decline) *(Gall 2015)*. Other global databases, such as CRED EM-DAT, record only droughts and glacial lake outbursts. As a result, losses and damages arising from SOP are often unrecorded and thus not considered at the political level *(Thomas and Benjamin, 2018)*. To promote **visibility and political attention to SOP**, global databases should be expanded to fully cover SOP. These could be integrated into policy frameworks such as the Sendai Framework of UNDRR or within the WIM process of UNFCCC. The UNFCCC's TEG-SOE, which targets the topic of SOP from several perspectives (see the *Infobox: SOP in the loss and damage sphere and under the WIM*), is collaborating with other expert groups to consider topics more holistically. In general, **enhanced collaboration** between stakeholders involved in SOP and cross-cutting issues is vital for sustainably governing SOP and creating synergies.

The **CRM framework** is a good example of a **risk management framework** that considers the governance dimension and other gaps. It helps decision makers identify risks related to hazards from SOP and from the interrelations between SOP and EWE, as well as context-specific CRM measures. It can be implemented on differing levels and be informed by agendas from local to international levels. The assessment includes evaluating the magnitude of the expected impacts and identifying the costs and benefits of the most promising risk management options. Based on this assessment, decision makers can prioritise, fund, and implement options. They thus learn about the importance of addressing potential losses and damages from SOP and the considerable long-term costs of failing to do so. **As it is commonly known, the costs of anticipatory planning and action pay off in comparison to the opportunity costs of inaction.** Monitoring and evaluation of the implemented measures can further instil **continuous learning** that feeds back into stages of the CRM framework in order to inform future decisions, thus **enabling long-term strategising and planned follow-up** for comprehensively dealing with SOP.

One important goal of the CRM framework is to help **fill knowledge and capacity gaps through a multi-stakeholder approach and awareness raising** (risk communication), **mainstreaming into sectors, and learning.** Mainstreaming climate risks, including those risks arising in the context of SOP, into relevant processes and policies at the national and sub-national level requires, among others: (1) **fostering holistic understanding and consideration of climate change impacts**, potential limits of adaptation and DRR, and available options to manage losses and damages **in all affected sectors**; (2) **strengthening inter-ministerial coordination**; and (3) **filling identified gaps to effectively assess and manage losses and damages** (for example, through the development of specific tools, specific data collection, appropriate human and financial resources, institutional rearrangements).

Mainstreaming CRM into national and sub-national development planning responds to the three major post-2015 agendas – the Sendai Framework, the Paris Agreement, and the 2030 Agenda. Implementing CRM with all three agendas in mind can then translate synergies from the international level to the national or sub-national levels. Currently, viable areas for including CRM information are National Adaptation Plans, Nationally Determined Contributions and reporting for the Sendai Framework.

Research and development agencies have an important role to play to support this process by working together to better understand SOP, enhance existing approaches, and develop new strategies to comprehensively and sustainably foster resilience towards SOP. Advancing the understanding of incentives for decision makers at all levels to factor in SOP and their interactions with other hazards should be another priority. Thirdly, state-of-the-art knowledge transfer with the goal of providing knowledge in an 'actionable manner' (translating knowledge into policy) is generally a valuable contribution to enable discussions and climate change literacy among those in charge of implementation. Workshops involving both technical staff and decision- and policymakers are an important means to foster mutual understanding.

Salinisation of soils in La Union, Peru.

4. The way forward: next steps on the path towards strengthened resilience to SOP

It is clear that better understanding the characteristics and potential consequences of the various SOP, especially in the context of climate change and for developing countries, is paramount for achieving progress towards the goals of the major post-2015 agendas – the UNFCCC Paris Agreement, the Sendai Framework for Disaster Risk Reduction, and the 2030 Agenda's SDGs. While all actors involved in these agendas have their roles to play, research and development cooperation agencies can deliver pioneering contributions to dealing with SOP.

The key findings organised around the different components of the CRM cycle summarised below are intended as food for thought and ideas for future collaboration between research and development cooperation. Keeping SOP in the spotlight when assessing, communicating, and managing risk or when developing climate policies on different levels, is the first and most essential step. Initial ideas of how to do this have been discussed in this paper. Pivotal next steps are to focus work on trying and testing CRM strategies, including CRA approaches, to derive evidence and advance the portfolio of measures for managing climate risks related to SOP. Last, but not least, mainstreaming good practice approaches into governance strategies should be encouraged.

Climate risk assessment

To address the challenges of indirect, complex, and long-term risk causation associated with SOP, a combination of methodological approaches is recommended.

- SOP should be analysed and communicated with regard to their specific potential impacts; for example, impacts from sea level rise include coastal flooding and erosion as well as saltwater intrusion.
- Impact chains help to understand compounding hazards and risks, as well as the interaction of SOP risks with anthropogenic stressors, other SOP, or EWE. Impact chains can and should be co-developed with stakeholder and target group participation.
- Index development can overcome challenges relating to a generally limited awareness of the impacts of SOP; threshold values for certain timescales and spatial extents may be adopted in accordance with the needs of the system of interest and, once the threshold and the risk tolerance of the system has been found to be exceeded, a SOP can be considered to have 'struck,' which would then lead to the consideration of risk management options.
- Scenario assessment modelling can be used to determine the longer-term impacts of SOP. The interaction of SOP, such as sea level rise, with other hazards and EWE should be factored in.

Climate risk management measures

Generating evidence on the acceptability and effectiveness of CRM measures for SOP to fill the existing gap requires an iterative framework based on continuous learning. The following approaches are recommended.

- The complexity of risks related to SOP and the interaction between SOP and EWE can be targeted through comprehensive management combining measures from CCA and DRR as well as long-term resilience-building measures such as social protection and transformational approaches.
- The identification of the most effective mix of measures should be context-specific and based on participatory approaches to enhance the suitability, acceptance, effectiveness, and sustainability of the measures.
- The applicability of CRM measures to different SOP still needs piloting on the ground; evidence and good practices should be generated through pilot implementation activities and projects followed by upscaling action.

- The intensification of collaboration between research and development cooperation including local actors to better understand SOP, enhance existing approaches, and develop new strategies are integral to comprehensively and sustainably foster resilience towards SOP.

Decision-making and governance

Improved decision-making and governance related to SOP (and EWE) risks requires:

- The assessment and recording of SOP-related losses and damages in global databases and their consideration for informing international agendas such as those of the UNDRR and UNFCCC to increase the visibility of, and political attention to, the impacts of SOP;
- The mainstreaming of climate risks, including those arising in the context of SOP, into relevant processes and policies at national and sub-national levels as well as the mainstreaming of CRM into national and sub-national development planning;
- The integration of SOP risks and impacts across and within all affected sectors, and a holistic and adaptive approach that links communities, local, and regional authorities, and national action;
- The strengthening of inter-ministerial coordination and of dialogue and cooperation between the respective communities of practice;
- The implementation of robust monitoring, evaluation, and learning frameworks that feed back into an iterative integration process to flexibly adjust implementation of CRM measures and inform future decisions and resource allocations.

Opportunities through enhanced collaboration between research and development cooperation

Collaboration between research and development practitioners working on CRM is a vital step towards the integration of SOP and, eventually, towards increased resilience. The exchange of knowledge and experience is one of the most important steps in informing concept, project and strategy development processes. In this way, approaches can be designed and developed in the flexible manner required, a holistic understanding and integration of SOP risks and impacts can be fostered, and discussions leading to strengthened climate change literacy can be facilitated among stakeholders. Areas that would benefit from greater collaboration between research and development practitioners include consideration of how to:

- Fill capacity gaps through awareness raising, mainstreaming of risk management in all sectors, and learning;
- Foster dialogue and raise awareness around SOP-related losses and damages as well as CRM approaches, for example through programmes offering capacity development and dialogue facilitation to involve all relevant institutions and stakeholders;
- Jointly raise awareness of the benefits of risk-informed approaches and management; and develop ways for mainstreaming SOP across and within affected sectors;
- Fill identified gaps to effectively assess and manage losses and damages and transfer state-of-the-art knowledge into policy and decision-making in an 'actionable manner;'
- Advance understanding of relevant incentives for decision makers at all levels to factor in SOP and its interactions with other hazards.

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Project Profiles

This working paper has been compiled by the Global Programme on Risk Assessment and Management for Adaptation to Climate Change (Loss and Damage) and IIASA.

Global Programme on Risk Assessment and Management for Adaptation to Climate Change (Loss and Damage)

The **German Federal Ministry for Economic Cooperation and Development (BMZ)** has commissioned the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH to implement the **Global Programme on Risk Assessment and Management for Adaptation to Climate Change (Loss and Damage)**. This programme aims to provide German development cooperation and its international partners with tried-and-tested concepts for assessing and handling climate risks in regions that are particularly vulnerable to climate change. The programme has an overall term of eight years (December 2013–December 2021) and operates in several pilot regions and partner countries, such as the South Pacific, India, Tanzania, Central America, the Mekong Region, Senegal, the Philippines, and the Caribbean.

To reach its goal the programme focuses on:

i. **Developing approaches for climate risk assessment (CRA)**, including a **6-step CRA methodology** to assess climate risks integrating relevant aspects of L&D, a database with over 100 CRA methods available to decision-makers, and pilot applications of CRA in partner countries (India and Tanzania) that have improved knowledge of local risks.

ii. **Creating an action-guiding framework for climate risk management (CRM)**, a risk-based and iterative approach to managing climate-induced risks that covers the entire hazard spectrum from extreme weather events to slow onset processes.

iii. **Promoting knowledge management, enhancing capacities in partner countries, and facilitating dialogue among stakeholders** at the (sub-)national and international level. Towards this aim, the modular training course Dealing with Climate-related Loss and Damage within Climate Risk Management has been implemented globally.

iv. **Advising the BMZ in the international climate policy debate on L&D** under the United Nations Framework Convention on Climate Change and guided by the annual Conferences of Parties (COPs). The project has provided technical and organisational assistance to the Warsaw International Mechanism for Loss and Damage associated with Climate Change expert group regarding CRM. Innovative projects such as Human Mobility in the Context of Climate Change and the InsuResilience Global Partnership originated from programme.

International Institute for Applied Systems Analysis (IIASA)

The International Institute for Applied Systems Analysis (IIASA) is an independent, international research institute with National Member Organisations in Africa, the Americas, Asia, and Europe. Through its research programmes and initiatives, the institute conducts policy-oriented research into issues that are too large or complex to be solved by a single country or academic discipline. This includes pressing concerns that affect the future of all of humanity, such as climate change, energy security, population ageing, and sustainable development. Two IIASA research groups contributed to the report.

The **Systemic Risk and Resilience (ASA/SYRR)** research group analyses the increasingly systemic and existential socio-ecological risks associated with global and local change, and with policy, practice, and civil society co-generates options for building resilience. SYRR develops and applies agile systems science to address social-ecological risks that are embedded in complex systems and characterised by potentially cascading, irreversible, and existential consequences. The **Equity and Justice (POPJUS/EQU)** research group focuses on the human dimensions of selected globally relevant policy challenges, with the aim of delineating and advancing their analysis, management, and governance with special attention paid to the design and application of equity and justice frameworks. EQU has a specific focus on ethical questions in the context of distributive and procedural justice concerns that may arise within the currently living generation, as well as across current and future generations, and explores options to enable transformative policy change towards just societies.

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