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A framework for assessing climate change and disaster-related losses of biodiversity and ecosystem services

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UNU EHS
UN environment programme
UNDRR UN Office for Disaster Risk Reduction
apan asia pacific ADAPTATION NETWORK

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Abbreviations

BTR	Biennial Transparency Reports
CBD	Convention on Biological Diversity
DELTA Resilience	Disaster & Hazardous Events, Losses and Damages Tracking & Analysis
DRR	Disaster Risk Reduction
EBV	Essential Biodiversity Variables
FLRD	Fund for responding to Loss and Damage
FRAME-ECO	Framework to assess climate change and disaster-related losses of biodiversity and ecosystem services
GIS	Geographical information systems
IPCC	Intergovernmental Panel on Climate Change
ISC	International Science Council
IUCN GET	International Union for Conservation of Nature Global Ecosystem Typology
NAP	National Adaptation Plan
NbS	Nature-based Solutions
NCP	Nature's Contributions to People
SDG	Sustainable Development Goal
SEEA EA	System of Environmental-Economic Accounting – Ecosystem Accounts
UNDRR	United Nations Office for Disaster Risk Reduction
UNFCCC	United Nations Framework Convention on Climate Change

Glossary

Baseline
A minimum or starting point from which to compare other information (e.g. for comparisons between past and present or before and after an intervention) (IPBES, 2025a).

Biodiversity
The variability among living organisms from all sources – including terrestrial, marine and other aquatic ecosystems – and the ecological complexes of which they are a part. This includes variation in genetic, phenotypic, phylogenetic and functional attributes, as well as changes in abundance and distribution over time and space within and among species, biological communities and ecosystems (IPBES, 2025a).

Diverse values of nature
Nature is valued in diverse ways. These diverse values arise from the different lenses through which people interpret human–nature relationships (i.e. worldviews). Diverse values are grouped into three broad categories: i) intrinsic (nature's own worth), ii) instrumental (nature's utility) and iii) relational (relationship of people with nature) (IPBES, 2025a).

Hazard
A process, phenomenon or human activity that may cause loss of life, injury or other health impacts, property damage, social and economic disruption, or environmental degradation (UNDRR, 2017).

Hazardous event
The manifestation of a hazard in a particular place during a particular period of time (UNDRR, 2017).

Ecosystem
A dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit (CBD, 2025).

Ecosystem condition
An ecosystem's structure and functioning understood as the composition of biotic and abiotic elements and the flows of energy and materials through them (IPBES, 2025a; Grizetti and others, 2019; UNSD, 2024).

Ecosystem extent
An ecosystem's size, measured in spatial area and/or length or volume (UNSD, 2024).

Ecosystem services
The multiple benefits that humans derive from nature, encompassing provisioning (e.g. food, water), regulating (e.g. climate regulation, flood control), cultural (e.g. spiritual and recreational) and supporting services (e.g. nutrient cycling, soil formation) that underpin life on Earth (MEA, 2005a).

Extreme events
The occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable (building on the definition of "extreme weather or climate event" by IPCC, 2012).

Loss and Damage (L&D)
No agreed definition of the term "Loss and Damage" exists under the Convention, but the Cancun Agreements provide boundaries by referencing impacts from extreme weather and slow-onset events (UNFCCC, 2012).

Decision 2/CP.19 on establishing the Warsaw International Mechanism for Loss and Damage associated with climate change impacts acknowledges that "loss and damage associated with the adverse effects of climate change includes, and in some cases involves more than, that which can be reduced by adaptation" (UNFCCC, 2013).

Losses and damages
The adverse effects of climate-related stressors that cannot be or have not been avoided through mitigation or managed through adaptation efforts (van der Geest and others, 2019).

Nature's Contributions to People
All the contributions, both positive and negative, of living nature (i.e. all organisms, ecosystems and their associated ecological and evolutionary processes) to people's quality of life (IPBES, 2025a).

Reference level
The value of a variable at the reference condition against which it is meaningful to compare past, present or future measured values of the variable (UNSD, 2024).

Risk (disaster risk)
The potential loss of life, injury or destroyed or damaged assets that could occur to a system, society or community in a specific period of time, determined probabilistically as a function of hazard, exposure, vulnerability and capacity (UNDRR, 2017).

Slow-onset events
Events that evolve gradually from incremental changes occurring over many years or from an increased frequency or intensity of recurring events (UNFCCC, 2012).

Sudden-onset event
A single, discrete event that occurs in a matter of days or even hours (UNFCCC, 2012).


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Executive summary

This report introduces a framework for assessing climate change and disaster-related losses of biodiversity and ecosystem services. In response to ecosystem degradation, biodiversity declines and cascading impacts on human well-being, this framework aims to fill data gaps through a standardized approach to identifying, monitoring and assessing such losses.

Discussions on loss and damage have been gaining traction at multiple levels of governance and society, particularly as losses to the environment are often not captured comprehensively. While some instrumental values of nature, such as the provision of crops, are considered in assessments of losses, many of the less tangible losses require more attention, particularly considering their adverse cascading effects on society, including on health, well-being, habitability, opportunities, dignity and identity (UNFCCC, 2024). The lack of comprehensive documentation of losses related to biodiversity and ecosystem services is a major barrier to informed planning, prioritization of actions and decision-making, such as in the context of implementing the Sendai Framework for Disaster Risk Reduction, the Paris Agreement and the Kunming-Montreal Global Biodiversity Framework.

Against this background, this framework aims to: i) achieve a better understanding of losses of biodiversity and ecosystem services; ii) guide countries through comprehensive assessments of losses related to ecosystem extent, ecosystem condition, including biodiversity, and diverse values of nature and ecosystem services using available data, methodologies and tools; and iii) support country-level programming to avert, minimize and address these losses.

This framework consists of two main components: i) the hazard context and ii) the ecosystem and biodiversity context. The hazard context ranges from extreme and sudden-onset events, such as storms or floods, to slow-onset events, like sea level rise, temperature increases or ocean acidification. While the primary focus of this report is on events related to climate change, it is applicable to non-climate-related hazards, such as earthquakes, as its general components and approaches are universal. The ecosystem and biodiversity context encompasses three interrelated dimensions: i) ecosystem extent, ii) ecosystem condition, including biodiversity, and iii) the diverse values of nature and ecosystem services. Negative changes in any of these dimensions are assumed to indicate potential losses when they coincide with hazardous events in space and time. Regular monitoring of both components is, therefore, essential and serves as the basis for loss assessments through the establishment of reference levels.

Reference-level monitoring is a central element of this framework, as it enables comparison between the state of the ecosystem dimensions before, during and after hazardous events. This framework aligns with international statistical standards for reference-level monitoring, particularly the System of Environmental-Economic Accounting – Ecosystem Accounting, and integrates diverse data sources, including quantitative data from remote sensing, in situ measurements and qualitative data from participatory methods and community-based sources, including indigenous and local knowledge.

The framework proposes distinct approaches for assessing losses related to extreme and sudden-onset events as well as slow-onset events. For extreme and sudden-onset events, reference-level data on ecosystem and biodiversity dimensions collected before the event are compared with post-event data, with negative changes indicating losses. Conversely, slow-onset events rarely have a clear starting point. Assessments, therefore, require comparing reference-level data collected at multiple time points with the most recent data to detect changes.

Beyond the mere identification of loss of biodiversity and ecosystem services, this framework informs multiple use cases. Regular monitoring supported by this framework can inform ecosystem management, conservation, restoration, nature-based solutions, and exposure and vulnerability assessments. It can also contribute to natural capital accounting.

This framework further provides a basis for supporting Parties under the United Nations Framework Convention on Climate Change and the Paris Agreement, by reporting and explaining loss and damage specific to their contexts. It is also a resource for work under the Warsaw International Mechanism for Loss and Damage, its Executive Committee and the Santiago Network, by strengthening standardized assessments of biodiversity and ecosystem service losses.

Countries can further utilize the framework to identify gaps relating to biodiversity and ecosystem losses and to access finance to address them, including

through the Fund for responding to Loss and Damage. The framework can also support the development of countries' Biennial Transparency Reports, National Adaptation Plans and, potentially, reporting under the Global Goal on Adaptation. It aligns with the priorities of the Sendai Framework for Disaster Risk Reduction by advancing understanding of disaster risk and enabling improved reporting on ecosystem-related impacts, while complementing disaster tracking systems, such as the Disaster & Hazardous Events, Losses and Damages Tracking & Analysis (DELTA) Resilience system, through structured integration and tracking of environmental losses.

It is important to note the limitations of this framework as it attempts to simplify a highly complex topic. These limitations include the challenge of distinguishing between extreme and sudden-onset events versus slow-onset events, the identification of climate change and hazards as primary drivers of losses, and the spatial and temporal dynamics of ecosystems and related losses.

This presented framework provides a basis to advance the assessment of climate change and disaster-related losses of biodiversity and ecosystem services, particularly in contexts where data on such losses are limited. The next critical step is to apply the framework across diverse contexts, considering data availability, ecosystem types and hazardous events. Such applications are essential to refine methodologies, identify suitable metrics and indicators, capture context-specific dynamics, interpret losses and ensure the framework's practical relevance, robustness and adaptability across diverse settings.

Guidance for the reader

This report contains six chapters. Chapter 1 elaborates on the background and objectives of the framework. Chapter 2 provides an overview of the framework, which is then presented in depth in chapters 3, 4 and 5. Chapter 6 concludes with important considerations related to the framework.

Policy-relevant information is presented in the executive summary, chapter 2, chapter 5.3, chapter 5.4 and chapter 6.

There is also an accompanying online resource: "Annex A – Data sources collection to support the assessment of climate change and disaster-related losses of biodiversity and ecosystem services". This compilation serves to inspire everyone who wants to apply the framework by demonstrating which kinds of data might be useful.

1. Background and objective

Climate change is threatening ecosystems in multiple ways, causing widespread biodiversity loss and long-term, potentially irreversible ecosystem shifts (IPCC, 2023). Climate-related hazards trigger disasters that lead to losses in ecosystem services and biodiversity, harming human systems (UNFCCC, 2024). Although these losses threaten the quality of life for present and future generations (IPBES, 2019), they remain poorly understood. Gaining a better understanding is essential for effective planning and implementation of disaster risk reduction (DRR) measures, especially to avert, minimize and address losses in biodiversity and ecosystem services and their effects on people and communities. This understanding must cover risks from natural hazards and climate change threats that can exacerbate vulnerabilities and harm ecosystems and human well-being.

Despite discussions on loss and damage gaining traction at multiple levels of governance and society, relevant authorities, researchers and civil society still face significant challenges. These stem from the varied definitions of “loss” across geographies and the inherent complexity of loss-assessment processes, particularly those related to environmental typologies, such as biodiversity and ecosystem services. The lack of a standardized framework for assessing and monitoring biodiversity and ecosystem service losses related to climate change and disasters limits countries’ capacity to respond.

Historical understandings of losses have focused on those that can be easily identified, quantified and monetized, while our understandings of non-economic losses – that is, those that may not constitute direct loss of revenue or those that are irreducible to economic terms – are nevertheless significant and deserve greater attention.

The development of a framework to assess such different losses is a concrete step towards enriching the discussion on standards and methodological guidance. Therefore, it helps represent and respond to climate change and disaster-related losses of biodiversity and ecosystem services. It contributes to:

1. Achieving a better understanding and awareness of these types of losses.
2. Guiding countries using available data, methodologies and tools to assess climate change and disaster-related losses related to ecosystem extent and condition (including biodiversity, diverse values of nature and ecosystem services), while also supporting the generation and collection of primary data using accessible national and global sources, including remote sensing and satellite imagery.
3. Supporting more effective, responsive, country-level programming to avert, minimize and address climate change and disaster-related losses of biodiversity and ecosystem services.

Through this, the framework deepens understanding of biodiversity and ecosystem-services losses, contributing to overall risk understanding and, therefore, supporting the priorities for action of the Sendai Framework for Disaster Risk Reduction, as well as relevant elements of the Rio Conventions. In view of cascading risks, the framework prioritizes assessing the primary impacts on biodiversity and ecosystem services, establishing a foundation for understanding subsequent consequences for human communities, as losses related to biodiversity and ecosystem services have direct and indirect impacts on socioecological systems, affecting livelihoods, security, health, well-being, opportunities, dignity and identity (UNFCCC, 2024).

A better understanding of these losses supports risk-informed decision-making and policy development, contributing to increasing resilience. The knowledge generated from the framework can, for example, inform restoration initiatives and nature-based solutions (NbS) for resilient recovery, promote the consideration and integration of diverse values of nature in spatial planning, and contribute to global discussions on losses and damages. It can also directly support countries in articulating evidence-based needs to access funding, including from the Fund for responding to Loss and Damage, and can be included in or inform requests for technical assistance under the Santiago Network.

The framework further supports achieving the targets of the Kunming-Montreal Global Biodiversity Framework – particularly Target 8: to “Minimize the Impacts of Climate Change on Biodiversity and Build Resilience” – and achieving Sustainable Development Goals (SDGs) (particularly SDG 13 – Climate action, SDG 14 – Life below water and SDG 15 – Life on land).

To leverage the potential of the framework to contribute to these processes, it primarily aims to inform the work of policymakers at the national level. These include national ministries, such as for the

environment, National Statistics Offices and Disaster Risk Reduction and Management agencies, as well as national loss and damage focal points. These actors can facilitate the application of the framework and its findings into the development and implementation of national strategies and plans, including, but not limited to, DRR strategies, National Adaptation Plans (NAPs) and Biennial Transparency Reports (BTRs). As the governance of loss and damage is country-specific, the uptake of the framework should be guided by respective national contexts. The described user groups and institutional entry points are not prescriptive.

2. Overview of the framework

The framework to assess climate change and disaster-related losses of biodiversity and ecosystem services (FRAME-ECO) comprises two main components: i) the hazard context and ii) the ecosystem and biodiversity context. The component hazard context specifically considers a continuum of extreme and sudden-onset events and slow-onset events, with climate change being a major driver of losses (IPCC, 2022) (see chapter 3). The component ecosystem and biodiversity context consists of three dimensions: i) ecosystem extent, ii) ecosystem condition, including biodiversity, and iii) diverse values of nature and ecosystem services (based on the System of Environmental-Economic Accounting – Ecosystem Accounting [SEEA EA], UNSD, 2024; IPBES, 2019, see chapter 4). Notably, the dimensions of ecosystem extent and condition influence diverse values of nature and ecosystem services, particularly with regard to regulating services, which help mitigate risks and, in turn, influence the extent of hazard impacts.

The framework builds on the assumption that negative changes in these three dimensions may indicate climate or disaster-related losses, especially where they spatially and temporally coincide and are associated with hazardous events. This operational assumption is used as a pragmatic proxy to support monitoring where formal attribution analysis is not feasible and does not imply direct causal attribution between observed changes and specific hazards or climate drivers. Therefore, hazard context and ecosystem and biodiversity context are to be regularly monitored and overlaid in a spatially and temporally explicit manner. How this is done differs from extreme and sudden-onset events to slow-onset events and is explained in chapter 5.1.

The framework is an outline, designed to be applied at different scales for loss assessments at local, regional, national or international level, depending on the scale at which losses are to be observed. Assessment at the different scales requires use of different data sources, from local to global data (more information on data sources and tools is in the document "Annex A – Data sources collection to support the assessment of climate change and disaster-related losses of biodiversity and ecosystem services"). Figure 1 illustrates the overall framework and highlights the process of assessing losses of biodiversity and ecosystem services. Each framework component and step of the loss assessment are detailed in the following chapters. However, it has to be noted that this framework is an approach to inspire loss and damage assessment, which in turn is expected to be the practical application to be undertaken in different country contexts.

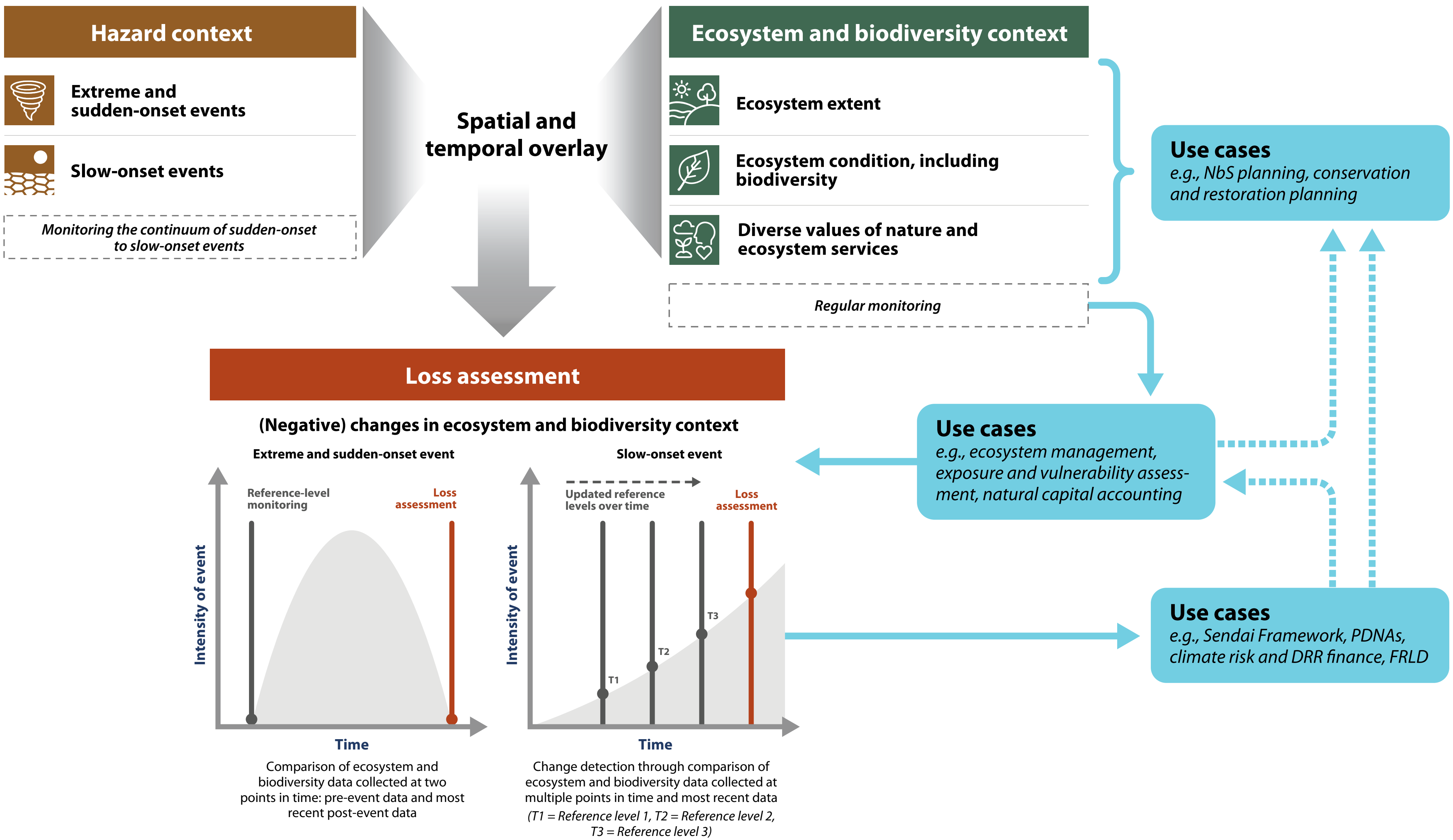

Figure 1: Framework for assessing losses of biodiversity and ecosystem services. Arrows indicate use cases, while dotted lines show feedback loops. PDNAs = Post-Disaster Needs Assessments.

Source: Authors.

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3. Hazard context

For the loss assessment, it is necessary to understand the hazard context that drives losses of biodiversity and ecosystem services in a given area. For this framework, hazards comprise a continuum of extreme and sudden-onset events and slow-onset events.

The term "extreme events" is mainly used by the climate change and loss and damage communities (see, for example, UNFCCC, 2025), and builds on the Intergovernmental Panel on Climate Change (IPCC) definition of extreme weather or climate events as "The occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable" (IPCC, 2012).

Sudden-onset events are defined as "a single, discrete event that occurs in a matter of days or even hours" (UNFCCC, 2012) and are categorized as per the hazard classification of the United Nations Office for Disaster Risk Reduction and the International Science Council (UNDRR and ISC, 2025). In this current framework, primarily extreme and sudden-onset events related to climate change are considered (i.e. those events increasing in frequency and magnitude due to climate change). The primary focus on these events stems from the prominent global discussion around climate change-related losses and damages and how to address them, which the framework strives to contribute to. However, the framework is also more broadly applicable to non-climate-related hazards, such as earthquakes, as its general components and approaches are universal.

Including references to both extreme events and sudden-onset events broadens the work of climate change adaptation, loss and damage and the DRR communities. This approach also allows for events that do not fit neatly into a sudden-onset and slow-onset classification. For example, drought cannot be easily classified as either. Rainfall and other data may indicate its general start and end, but drought is not considered a sudden-onset event; it also is not continuous (with no clear end) in the way slow-onset events are. In the United Nations Framework Convention on Climate Change (UNFCCC), drought is classified as an extreme event (UNFCCC, 2012).

The slow-onset events considered for the framework follow the definition of UNFCCC (2012) to "evolve gradually from incremental changes occurring over many years or from an increased frequency or intensity of recurring events". At this stage, this framework considers the following as slow-onset events: sea level rise, increasing temperatures, ocean acidification and glacial retreat. The loss assessment requires spatially and temporally explicit information on such events.

Assessment of hazardous events can be done using remote sensing data, geographical information systems (GIS) and in situ monitoring to map the spatial extent and the respective intensity of the event(s) in question for the assessment of losses to be undertaken. For example, the extent and depth of the inundated area after a flood or the temperature and soil moisture during a drought can be documented to record the intensity of the given event(s). For each type of event, hazard characteristics (e.g. extent and intensity) are assessed differently and require fit-for-purpose metrics. These are documented in the Hazard Information Profiles (UNDRR and ISC, 2025).

Disaster and meteorological communities (scientific entities such as hydrometeorological or oceanographic services) are already conducting assessments on extreme and sudden-onset events and slow-onset events, and their work can provide an important foundation for hazard information. Existing statistical and monitoring frameworks that track hazardous events and related losses, such as the Sendai Framework Monitor and the Global Disaster-Related Statistics Framework, should be considered and used.

To address data gaps and uncertainties, it is recommended to integrate diverse data sources, such as remote sensing, field surveys, citizen science and indigenous knowledge. Sensitivity analyses and transparent reporting of uncertainty (e.g. confidence intervals, data limitations) should be standard practice, supporting risk-informed and adaptive decision-making.

4. Ecosystem and biodiversity context

Hazardous events can have various detrimental impacts on biodiversity and ecosystems (see, for example, IPCC, 2022; IPBES, 2019; UNFCCC, 2024). To assess how these manifest as losses, it is essential to first understand the context in which the assessment of losses is to be performed.

Therefore, the ecosystem and biodiversity context is an integral component of the presented framework and includes three dimensions: i) ecosystem extent, ii) ecosystem condition, including biodiversity, and iii) diverse values of nature and ecosystem services.

The extent of an ecosystem refers to its size, measured in spatial area and/or length or volume (UNSD, 2024). The condition of an ecosystem in this framework is understood to reflect an ecosystem's structure and functioning and can be referred to as the composition of biotic and abiotic elements and the flows of energy and materials through them (IPBES, 2025a; Grizetti and others, 2019; UNSD, 2024). Biodiversity is fundamental to the condition of ecosystems; scientific evidence highlights that species' functional characteristics determine ecosystem properties and the flow of material and energy (Maes and others, 2013; Hong and others, 2021; Hooper and others, 2005). The diverse values of nature are highlighted by the concept of Nature's Contributions to People (NCP), which integrates both material and non-material benefits of nature, while acknowledging different cultural backgrounds and worldviews that shape how people relate to the natural world (Díaz and others, 2018). Within this broader framing, the concept of ecosystem services offers a structured way to describe these benefits, referring to provisioning (e.g. food, water), regulating (e.g. climate regulation, flood control), cultural (e.g. spiritual and recreational) and supporting services (e.g. nutrient cycling, soil formation) that underpin life on Earth (MEA, 2005a). Ecosystem services are a fundamental contribution to human well-being, as the support provided by the natural environment constitutes the basis for human security, resources for livelihoods, health, good social relations and freedom (MEA, 2005b).

This structure acknowledges that the extent and condition of ecosystems, including their biodiversity, are fundamental for their functioning. Changes in extent and condition can have negative impacts, with palpable effects on the composition of biotic and abiotic elements and the flows of energy and materials. Further, the extent and condition of an ecosystem, as well as the state of its biodiversity, largely determine its capacity to provide ecosystem services and diverse values to different groups of people.

However, this framework also acknowledges that ecosystems are highly dynamic, as defined by the Convention on Biological Diversity (CBD, 2025): "A dynamic complex of plant, animal and microorganism communities and their non-living environment interacting as a functional unit". Ecosystems evolve over time, resulting from changes in environmental conditions through cycles of disturbance and recovery. In addition, ecosystem conditions may also be influenced by ongoing human-induced pressures – such as resource overexploitation, extractive activities and land-use changes related to urbanization or agricultural practices – which can interact with natural disturbances and shape observed ecosystem changes. Often, these disturbances – such as wildfires, large-scale floods or pest outbreaks – are essential for maintaining ecological integrity and enabling renewal processes. For example, certain forest or wetland ecosystems depend on periodic flooding or fire to regenerate, maintain species diversity or reset successional stages (see, for example, Rowe and Scotter, 1973; Sandi and others, 2020).

The essential nature of some natural disturbances to ecosystem health should also be considered to capture the natural variability and disturbance-driven dynamics of ecosystems and distinguish them from changes that exceed natural boundaries and lead to degradation or loss. This is why regular monitoring is encouraged and considered essential in understanding ecosystem dynamics. Monitoring disturbances is highly relevant for providing reference levels for the ecosystem context and can serve as a basis for comparing changes in relation to the hazard context. Furthermore, it supports a better understanding of ecosystems and informed decision-making regarding ecosystem management.

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5. Assessing climate change and disaster-related losses of biodiversity and ecosystem services

When spatial and temporal overlays show that hazardous events coincide with and result in changes of ecosystem extent, condition or services, or diverse values of nature, then there may have been losses in biodiversity and ecosystem services.

An assessment should be conducted at this point to capture negative changes in the ecosystem and biodiversity context related to the hazardous events.

The loss assessment compares the post-event conditions of the ecosystem and biodiversity context with pre-event conditions. Baseline and reference-level data, as well as reference-level monitoring, are thus required to compare with most recent data and determine losses. For this framework, both "baseline" and "reference level" terms are used. It should be acknowledged that a baseline might be associated with an optimal state, which is hard to determine for an ecosystem. Comparatively, a reference level is more flexible, as it considers the dynamic status of ecosystems as a basis, including prior to an event, at a certain point in the past, or in its natural/pristine state. This terminology is aligned with the SEEA EA (UNSD, 2024). Reference levels should be periodically reviewed and updated to reflect new scientific knowledge and changing ecological conditions so they are as relevant, actionable and scientifically robust as possible. This approach is consistent with best practices in ecological monitoring and restoration (IPBES, 2019; Leclère and others, 2020). Importantly, reference-level data and the data used for periodic comparison need to be measured under the same conditions. For example, certain types of wetlands are more vulnerable to changes during a dry season, and losses during a dry season (e.g. due to wildfires) should not be assessed against the condition of the same wetland during a wet season.

How the reference-level monitoring and the loss assessment are conducted depends on whether the negative changes in the ecosystem and biodiversity context are related to extreme and sudden-onset events or slow-onset events, as described in chapter 5.1.

5.1. Reference-level monitoring for the assessment of losses for extreme and sudden-onset events and slow-onset events

Extreme and sudden-onset events tend to cause immediate, measurable damage that can be captured through rapid or initial assessments, while slow-onset events lead to gradual, cumulative losses that are often harder to quantify and qualify and require long-term ecological monitoring and context-specific evaluation. However, in practice, slow-onset and extreme and sudden-onset events can overlap and interact along a continuum of events (see chapter 6). This framework treats them as two categories for analytical clarity and distinct assessment of losses. Some losses related to a storm surge, for example, can (theoretically) be assessed right after the event using reference data from the pre-event phase. Ocean acidification, on the other hand, does not have a defined start or end point. Therefore, it is unclear at what point the assessment of losses is to be performed and which data should best serve as reference data. Determining losses related to slow-onset events, therefore, requires more long-term tracking. In line with established assessment methodologies, rapid assessments primarily capture immediate damages and observable effects, while longer-term losses and impacts emerge progressively during the recovery period. The terminology "slow-onset events" is commonly used in the context of climate change (UNFCCC, 2024) and will also be adopted in this framework. Since there are often events with no clearly determinable start or end points, some conceptually consider these are processes (UNDRR, 2023). For both extreme and sudden-onset events and slow-onset events, reference-level data are required against which the most recent data (for extreme and sudden-onset events: post-event data) can be assessed to determine losses.

5.1.1. Extreme and sudden-onset events

Looking more closely at extreme and sudden-onset events, baseline or reference-level data refers to pre-event data. This includes data on ecosystem extent, condition/biodiversity, values and services collected continuously before the event in question. To assess loss, post-event data on the same variables are compared with this reference-level data. The observed change, such as reduction of ecosystem extent or reduction of net primary productivity after the event, indicates potential losses. This is illustrated in figure 2.

To support the operationalization of the approaches proposed in this framework, the Disaster & Hazardous Events, Losses and Damages Tracking & Analysis (DELTA) Resilience system is identified as a key implementation platform. Developed by UNDRR in collaboration with the World Meteorological

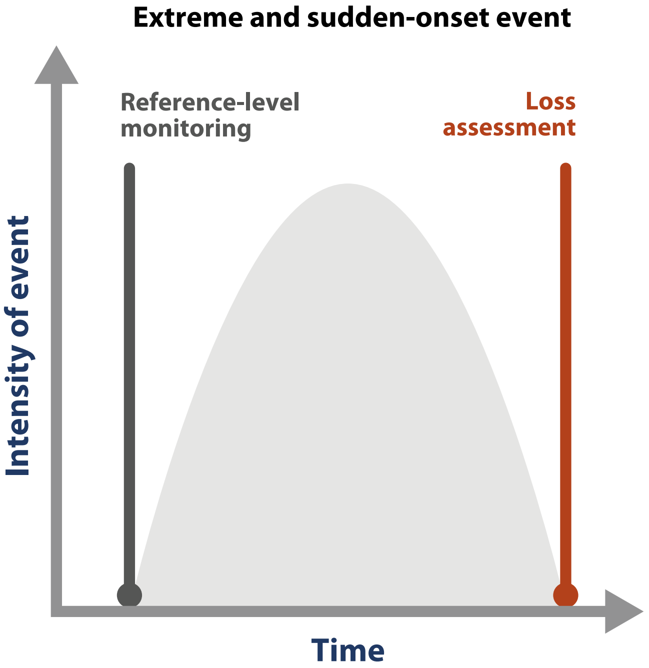

Figure 2: Reference-level monitoring and assessment of losses in the context of extreme and sudden-onset events. Example: assessing the extent and condition of a riparian forest before and after a flood event.

Source: Authors.

Organization and the United Nations Development Programme, DELTA Resilience provides a standardized structure for tracking hazardous events together with associated damages and losses across sectors and hazard types. Its integrated approach – linking hazard characteristics, exposure and vulnerability conditions, and observed effects – enables progressive incorporation of more comprehensive losses information, including biodiversity and ecosystem-services losses as outlined in this framework. While current applications are particularly suited to documenting losses associated with extreme and sudden-onset events, the framework can capture longer-term and cumulative losses, including those linked to slow-onset events. The framework, therefore, builds upon DELTA Resilience by helping to identify and structure additional data and assessment dimensions required for more comprehensive losses tracking over time. A detailed overview of the DELTA Resilience system is provided in Box 1.

5.1.2. Slow-onset events

Compared with extreme and sudden-onset events, developing a standardized approach to track and assess losses from slow-onset events is more complex. Figure 3 shows that establishing a data baseline or a reference level ideally builds on data collection at multiple points in time prior to the assessment of losses. Because slow-onset events often lack a delineable start date, monitoring and collecting data at multiple points in time enables the collection of pre-event data while accounting for changing reference levels. Ideally, such monitoring of ecosystem variables and biodiversity is continuously conducted in countries.

The above-described steps for mapping and monitoring are given as inspiration for how to do so. It is, however, acknowledged that such monitoring systems are often not in place and, therefore, limited data are available. For both slow-onset and extreme and sudden-onset events, anecdotal data should be included alongside data obtained through remote sensing, modelling or ecological in situ measurements. This may include information collected through participatory mapping or storytelling, as well as alternative data and information formats, including pictures or testimonies. Integrating diverse data sources, including both quantitative and qualitative data, enhances spatial and temporal coverage, improves result accuracy and supports the comprehensive assessment of losses, particularly where data gaps exist. Such data and information can be captured using the UNDRR DELTA Resilience system.

Box 1: Disaster & Hazardous Events, Losses and Damages Tracking & Analysis (DELTA) Resilience

Disaster & Hazardous Events, Losses and Damages Tracking and Analysis (DELTA) Resilience is a next-generation disaster tracking system developed by the United Nations Office for Disaster Risk Reduction in collaboration with the World Meteorological Organization and the United Nations Development Programme. It supports countries in systematically recording hazardous events together with associated damages and losses using a standardized and risk-informed data structure. More than a software application, DELTA Resilience combines methodological frameworks, data standards, governance arrangements, capacity development and open-source digital tools to strengthen nationally owned disaster tracking systems.

Unlike traditional disaster loss databases that primarily document damages and economic losses after events occur, DELTA Resilience integrates information across the disaster risk continuum. The system records hazardous events – including their spatial and temporal extent and physical characteristics, such as magnitude and intensity – alongside observed damages, service disruptions and losses across sectors. It also enables the inclusion of reference information on pre-event exposure and vulnerability conditions, allowing losses to be analysed in relation to underlying risk drivers.

DELTA Resilience follows internationally aligned hazard classifications and supports standardized reporting across hazards, sectors and geographic scales. Data can be disaggregated across population groups, including by sex, age and disability, when referring to human impacts, and the system allows documentation of both economic and non-economic losses, such as health effects, displacement and service disruptions.

By linking hazardous events, exposure and vulnerability conditions, damages and losses within a single structure, DELTA Resilience provides a foundation for progressively expanding disaster loss accounting. This includes the integration of biodiversity and ecosystem-services losses through comparison of post-event changes against ecological reference conditions and ongoing monitoring approaches.

For further information, see:
DELTA Resilience: Disaster losses and damages tracking system (deltaresilience.org)

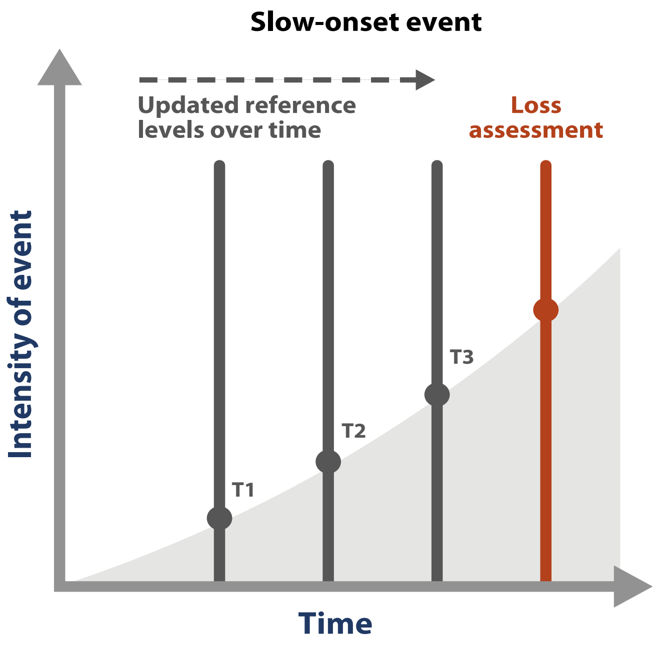

Figure 3: Reference-level monitoring and assessment of losses in the context of slow-onset events. Example: assessing coral reef condition under progressive ocean acidification and warming.

Source: Authors.

In contrast to assessing losses induced by extreme and sudden-onset events, determining losses from slow-onset events requires not only comparison of data from two points in time, but change detection that builds on a comparison of data on ecosystem extent, condition/biodiversity and services and values collected at multiple points in time prior to and during the event with the most recent data. This is because slow-onset events are, in fact, continuous processes in which losses accumulate. Hence, tracking and assessing related losses require long-term monitoring, especially since slow-onset events, such as sea level rise and temperature increase, are not expected to halt in the near future, and losses might continue to occur. Countries lacking regular monitoring can initiate periodic surveys, establish sentinel sites and participate in global observation networks to build long-term data sets. By employing low-cost sensors, community-based monitoring and remote sensing, data collection can be enhanced, enabling the detection of gradual ecosystem changes linked to slow-onset events.

Existing monitoring systems and data sets can help track slow-onset events and, therefore, support the assessment of related losses of biodiversity and ecosystem services for countries/regions that do not have their own tracking systems.

In the case of both extreme and sudden-onset events and slow-onset events, the data obtained at the point of, or shortly after, the event occurred can be used as the start for continuous monitoring of the ecosystem's extent, condition/biodiversity, services and values. Continuous reference-level monitoring provides a detailed picture of an ecosystem's state and enables monitoring of ecosystem recovery and the progression of losses in the context of slow-onset events, such as sea level rise. In the case of extreme and sudden-onset events, more long-term monitoring could also help track cascading losses occurring well after the initial event. In the face of future hazards, this data can be used as the basis for a new reference level against which further changes are measured.

5.2. Reference-level monitoring for assessing losses of biodiversity and ecosystem services

In order to assess climate change and disaster-related losses of biodiversity and ecosystem services, the baseline or reference level of the ecosystem and biodiversity context must be established. This chapter elaborates on reference-level monitoring for ecosystem extent (chapter 5.2.1), ecosystem condition, including biodiversity (chapter 5.2.2) and diverse values of nature and ecosystem services (chapter 5.2.3). The reference-level monitoring proposed here is aligned with SEEA EA as an already existing internationally agreed statistical framework.

Importantly, the framework accommodates for varying data types and availability, including high- and low-resolution data and community-drawn maps, among others. National- and/or local-level assessments of losses will, therefore, depend on what data are available as reference-level data relative to the point at which the loss is being determined. Appropriate limitations can be noted while acknowledging that there is value in using qualitative or anecdotal data to estimate the spatial extent of important ecosystems.

5.2.1. Ecosystem extent

Using spatially explicit data (such as remote sensing data and GIS) helps track changes in ecosystem services both spatially and temporally. The spatial component enables monitoring of the size of individual and interconnected ecosystems; the temporal component makes it possible to track the long-term changes in ecosystems that emerge and evolve over time. Existing and ground-truthed ecosystem maps can be simple or elaborate based on data available and in-country capacity and may also be relevant for the interpretation of remotely sensed data.

There is currently no single, universally (global) accepted definition or classification system for all ecosystems, although several major frameworks have been developed to promote greater harmonization at the global level. One of the most comprehensive is from the International Union for Conservation of Nature Global Ecosystem Typology (IUCN GET; IUCN, 2020a), which offers a hierarchical structure for

Box 2: The System of Environmental-Economic Accounting – Ecosystem Accounting

The System of Environmental-Economic Accounting – Ecosystem Accounting (SEEA EA; UNSD, 2024) is an internationally agreed statistical framework that provides standardized methods for measuring ecosystems, biodiversity and ecosystem services within an accounting structure consistent with national statistics. SEEA EA organizes information through ecosystem extent, ecosystem condition and ecosystem services accounts, enabling systematic observation of ecosystems and their changes over time.

In the context of disaster and climate change assessment, SEEA EA supports the establishment of reference or baseline conditions against which ecosystem changes can be assessed. By distinguishing ecosystem assets, their condition and the services they generate, the framework enables the identification of losses related not only to physical damage but also to declines in ecosystem functioning and service provision.

The reference-level monitoring proposed in this framework aligns with SEEA EA concepts and accounting structures, supporting consistency with internationally agreed statistical standards and facilitating integration with environmental and disaster-related statistics.

classifying ecosystems, ranging from broad functional groups, such as terrestrial forests or freshwater rivers, to more specific ecosystem types, such as tropical-subtropical forests or palustrine wetlands. SEEA EA supports the use of IUCN GET or equivalent national ecosystem classifications. An interactive web map enables the extraction of global or country-specific spatial ecosystem data, via IUCN GET, making it one of several practical tools supporting the collection of ecosystem extent data to establish a reference level aligned with global standards.

5.2.2. Ecosystem condition, including biodiversity

Ecosystem condition is defined by the quality of abiotic and biotic flows within an ecosystem. To capture abiotic and biotic flow quality and to establish a reference condition against which changes can be tracked, SEEA EA proposes a set of ecosystem conditions that guide the selection of variables and indicators. These include physical, chemical, compositional, structural and functional state characteristics, as well as landscape and seascape characteristics. Biodiversity-related indicators, including those aligned with Essential Biodiversity Variables (EBVs), can be integrated within condition accounts. The EBVs include variables such as genetic diversity, species abundance, phenology and primary productivity (GEO-BON, 2025). EBVs enable monitoring of and reporting on biodiversity change and indicators sensitive to ecosystem change, making these variables crucial for tracking ecosystem responses and losses under climate change and disaster impacts.

Tracking changes in the ecosystem condition, including biodiversity, can be supported by remote sensing and GIS. However, further in situ measurements of ecological variables or indicator species are pivotal for comprehensive assessments.

Many communities (both geographic and sectoral) who benefit directly from or live as part of ecosystems may have valuable insights into how these ecosystems have changed or are changing, particularly in reference to hazardous events. Such information may prove valuable on its own or for validating other observational records. National or community archives are also useful sources for reference-level and/or impact data on changes over time.

5.2.3. Diverse values of nature and ecosystem services

One specific ambition of the framework is to promote a more comprehensive perspective that considers, to the extent possible, diverse values of nature. The Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services framework on NCP can guide the assessment of diverse values. The framework builds on the ecosystem services concept, with its 18 reporting categories (MEA, 2005b), but provides additional guidance on assessing other values that cannot be captured adequately by the reporting categories. It gives equal importance to instrumental, relational and intrinsic values, such as cultural heritage or social cohesion, and applies a pluralistic valuation approach (IPBES, 2025b). The NCP approach considers diverse actors, disciplines and worldviews, such as more polycentric worldviews and indigenous and local knowledge systems, that view humans as living in, with or as nature, rather than living off nature (IPBES, 2019; IPBES, 2022).

Capturing such diverse values would enable a better understanding of cascading impacts of biodiversity and ecosystem service losses as defined by UNFCCC (2024), such as identity, dignity, habitability and other dimensions of well-being. As the NCP approach is yet to be operationalized, concrete data sources are not available. Nevertheless, countries should feel encouraged to check available and alternative resources and include qualitative statements, pictures and local and indigenous stories, obtained through participatory methods and other forms of communication, that can help to assess diverse values of nature and depict the impacts of hazards on ecosystems more comprehensibly (IPBES, 2019).

It is acknowledged that framing and capturing data on the diverse values of nature is complex and beyond what countries might be able to do. Focusing on assessing changes in ecosystem extent and condition is, therefore, a practical starting point for the assessment of losses. Nevertheless, exploring diverse values is highly encouraged to enable a holistic assessment of losses and what these losses mean for people.

The provision of ecosystem services can be mapped spatially and assessed using a wide range of methods, including modelling, in situ measurements and qualitative or quantitative analyses. Within the SEEA EA, assessment and mapping of ecosystem services follow a standardized approach carried out at the country level. Easily accessible web mapping resources that provide data from global data sets remain limited in their capacity to capture the full range of ecosystem services and specificities at national and subnational levels.

5.3. The assessment of losses

Capturing changes to the ecosystem and biodiversity context related to hazardous events enables the final assessment of losses.

This relies on the reference-level monitoring outlined in chapter 5.2, which is specific to the hazard context. By comparing the ecosystem and biodiversity context with previous points in time (reference levels), negative changes in ecosystem extent, condition and diverse values of nature and services can be identified. These negative changes, such as loss of coastal wetlands to sea level rise (changes in ecosystem extent), or climate-driven disappearances of species (changes in biodiversity) or the drying up of sacred waters (changes in diverse values), would be considered losses.

It should be noted again that this framework presents only an approach to fill gaps in data and understanding relating to ecosystem and biodiversity losses. To elaborate further and to ensure this framework's applicability, the next step is to use it for the assessment of losses in different hazard, ecosystem and country contexts.

5.4. Use cases of the framework

Through its component-based structure, this framework not only supports the identification and assessment of losses, but it can inform other use cases in the context of environmental management and policy development. By promoting regular monitoring of ecosystem extent, condition, biodiversity, diverse values and ecosystem services, and by enabling the structured assessment of losses, the framework supports building evidence for informed decision-making across conservation and restoration planning, DRR and climate risk finance.

5.4.1. Use cases informed by regular monitoring

An inherent part of the framework is the promotion of regular monitoring of the ecosystem context. Such monitoring directly supports ecosystem management by enabling practitioners and policymakers to track changes over time, identify past, current and future degradation trends and assess the effectiveness of management interventions.

Regular monitoring also informs exposure and vulnerability assessments by investigating how changes in ecosystem extent and condition affect the capacity of ecosystems to provide provisioning, cultural and regulating services, including those that contribute to mitigation of hazards (Mitchell and others, 2013; Grizetti and others, 2019). Any reduction of this capacity can increase the exposure and vulnerability of socioecological systems, including individuals, communities and ecosystems themselves, to climate-related hazards (Sudmeier-Rieux and others, 2021; Walz and others, 2021). By capturing these dynamics, regular monitoring enables a better understanding of risk and the development of targeted risk reduction strategies.

In addition, monitoring promoted by this framework can inform natural capital accounting processes. As the framework aligns with the United Nations SEEA EA, it supports efforts to compile standardized information on ecosystem extent, condition and service provision.

Beyond these direct applications, regular monitoring further informs planning processes, particularly NbS planning, as well as conservation and restoration planning. Information and data, particularly on changes in ecosystem condition, biodiversity and ecosystem services, are essential for identifying where NbS, conservation and restoration interventions are needed. The IUCN Global Standard for Nature-based Solutions (IUCN, 2020b) defines NbS as "actions that result in a net gain to biodiversity and ecosystem integrity". Compliance with this standard requires NbS to be based on evidence-based assessments of ecosystem state and prevailing drivers of degradation and loss. The framework supports this requirement by facilitating systematic monitoring and loss identification, thereby ensuring that NbS interventions directly respond to observed ecosystem needs rather than assumed conditions.

5.4.2. Use cases informed by the assessment of losses

The assessment of losses enabled by the framework directly supports international and national policy processes, including reporting under the Sendai Framework for Disaster Risk Reduction (Targets C and D) and potentially the Global Goal on Adaptation (Target 9d on reducing climate impacts on ecosystems and biodiversity). It can enhance transparency in loss and damage information processes, such as BTRs under the Paris Agreement, as well as inform national adaptation planning. When developing or updating their NAPs, for example, countries could integrate assessments of losses results into the assessment of climate hazards, vulnerabilities and risks, and impacts of climate change impacts, as well as into the development of climate change scenarios (Element A of the NAP development process; UNFCCC LDC Expert Group, 2025) to inform adaptation action that considers the environment.

Similarly, findings of assessments of losses can inform the development of national DRR strategies by identifying disaster risks, impacts and trends to guide appropriate interventions (Phase 1, Step 1 of the development of national DRR strategies process; UNDRR, 2019). By explicitly capturing biodiversity and ecosystem-services losses, the framework aids data collection that can inform targets of the Sendai Framework Monitor, including Target C, direct economic losses and Target D, specifically Indicator C-5 (direct economic loss resulting from damaged or destroyed critical infrastructure attributed to disasters) and Indicator D-4 (number of other destroyed or damaged critical infrastructure units and facilities attributed to disasters) (UNGA, 2016; Walz and others, 2021; Walz and others, 2022).

A better understanding of losses of biodiversity and ecosystem services informs engagement with the Santiago Network by helping countries articulate specific technical assistance needs and integrate environmental considerations into climate risk and DRR finance mechanisms, particularly in the context of the newly established Fund for responding to Loss and Damage (FLRD) (UNFCCC, 2024). As it enables countries to conduct assessments and report on the biodiversity and ecosystem service losses, one ambition of the framework is to further support the submission of funding requests more broadly.

At the international level, aggregated application of this framework can contribute to the knowledge base of the Warsaw International Mechanism for Loss and Damage, particularly informing the workstreams on slow-onset events, non-economic losses and comprehensive risk management. Systematic environmental loss data can support synthesis reports of the Executive Committee and strengthen coherence between DRR, biodiversity policy under the CBD, and the UNFCCC loss and damage agenda.

Integrating considerations of losses of biodiversity and ecosystem services into decision-making on climate risk and DRR finance also supports more effective allocation of resources to conservation, restoration and NbS, ensuring that such efforts receive adequate financial support to enhance DRR, adaptation and resilience.

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6. Important considerations related to this framework

1) When applying this framework, consider multi-hazard and compounding hazards perspectives when assessing losses. This is a key element of DELTA Resilience.

Although it is important to understand how the assessment of extreme and sudden-onset events differs from slow-onset events, it should be acknowledged that a clear distinction between the two is often challenging, as they are interlinked and might cascade, compound or influence each other. For example, IPCC reports that compounding heatwaves and droughts have become and are projected to become more frequent across multiple regions (IPCC, 2023). Other authors document that storm surges resulting from tropical cyclones are likely to intensify with a higher mean sea level (Lockwood and others, 2022). IPCC concludes that sea level rise compounding with storm surges and heavy rainfall events increases flood risks (IPCC, 2023). Similarly, scientific evidence shows that rising temperatures and arid tree biomass increase the likelihood of wildfires (Goodwin and others, 2021), and heatwaves are becoming more intense due to the interplay of higher temperatures and ocean–land–atmosphere interactions (Beobide-Arsuaga and others, 2025).

2) When applying this framework, adopt a conservative approach when attributing losses to a driver, whether climate change or other drivers. Explicitly document data gaps and uncertainty that influence the assessment of losses.

Beyond the complexity of defining start and end dates for assessing losses induced by slow-onset events, relating losses to these events as primary drivers is more challenging. As slow-onset events unfold over longer time periods, so do their impacts, usually resulting in more gradual than abrupt losses of biodiversity and ecosystem services, for example through species range shifts, localized extinctions, changes in phenology and changes in the composition, structure and function of ecosystems (Pecl and others, 2017; Heinze and others, 2021; Panetta and others, 2018; Román-Palacios and Wiens, 2020; IPCC, 2022). Disentangling the observed losses resulting from slow-onset events from those caused by other drivers, such as land-use change or pollution, is highly complex. This general assumption needs to be treated carefully, though, as there are instances where slowly unfolding processes cross thresholds and, in consequence, cause abrupt losses. Studies by Berdugo and others (2020, 2021), for example, explain how rising temperatures and increasingly arid conditions lead to abrupt changes in ecosystems' structural and functional attributes.

There is also a need to acknowledge the role of inherent ecosystem dynamics and climate variability as drivers of losses. IPCC explains that it "is often uncertain whether the changes are caused by a change in the mean [natural climate variability], variance [climate change-related extremes], or both" (IPCC, 2001). The same difficulty applies to the differentiation between natural ecosystem dynamics and changes related to hazardous events. Therefore, the presented framework takes a conservative approach, looking at all losses in a first step. More detailed assessments can shed more light on specific drivers and help understand which losses are related to the pertinent event(s). Establishing such in-depth understanding can be a first step towards actually attributing losses to climate change and/or specific events.

3) Implement this framework iteratively, starting with one or two priority ecosystems or hazards, to account for ecosystem complexity. Learnings can help enhance the assessment of losses in the next iteration, such as enabling better reflections on spatial dynamics or tipping points. When resources are available, implement regular monitoring for the collection of reference data that inform the assessment of losses, as well as additional use cases (such as NbS planning).

Further, this framework assumes that hazardous events have mainly detrimental effects on ecosystems and biodiversity, such as reductions in ecosystem extent and habitat fragmentation, deterioration of ecosystem condition and loss of species, and depletion of ecosystem services and diverse values of nature. It should be considered, however, that events do not always cause loss in all three of these dimensions. Liu and others (2018), for example, document that habitat fragmentation and associated biodiversity loss cause severe disruptions to ecosystem functions and worsening conditions in small patches. However, if the reduction in ecosystem extent is not as significant and the fragments remain rather large, ecosystem functions are observed to be well maintained, despite the disruptions. Therefore, a change in ecosystem extent related to a hazardous event does not automatically imply a loss of good condition, biodiversity or ecosystem services. It still must be considered that more frequent and intense events might, after all, exceed the resilience of ecosystems.

In addition, spatial and temporal dynamics of losses of biodiversity and ecosystem services must be kept in mind when performing an assessment of losses. Factoring in spatial dynamics is especially critical in the context of ecosystems that are highly interconnected. While hazardous events might seem to impact only one specific area or ecosystem, losses to biodiversity and ecosystem services within that ecosystem can affect others outside it (e.g. through upstream–downstream connections in riverine systems). Temporal dynamics should also be considered during an assessment of losses. For example, an assessment that is made shortly after a disaster unfolds (which is key and necessary for immediate emergency management and recovery) may hide long-term impacts that only manifest over time. Ferraz and others (2020) summarize studies that investigated the time lag between reoccurring disturbances and the manifestation of impacts on the structures and functions of a coral reef. They describe how cyclones, bleaching events and outbreaks of venomous starfish species led to a decline of living coral cover and overall biomass loss. In the long term, a decade after the initial series of events, species abundance and biomass were recorded as recovered. However, the coral ecosystems' nutrient cycling efficiency through the food chain was not. Overall, the ecosystem lost structural complexity and became less productive.

On the other hand, ecosystems can bounce back and regenerate over time. As an assessment of losses can only capture a snapshot of a regenerative process, it is unlikely to reflect whether the observed losses are temporary and the ecosystem can recover from them, or whether they are permanent. Though such temporal dynamics are important for understanding the impact of losses on ecosystems, they do not negate the temporal impact. It is also relevant to the future provision of ecosystem services, such as food and the regulation of extreme and sudden-onset events. Regular monitoring and collection of reference data are already important steps towards assessing such long-term losses. As it also allows for monitoring the dynamics of ecosystems, which need to be considered in the assessment of losses, such regular monitoring is highly encouraged. The application of this framework for the assessment of losses in different hazard, ecosystem and cultural contexts is needed to capture and understand such spatial and temporal dynamics more comprehensively.

The maturity of ecosystems, such as critical slowing down parameters, thresholds and tipping points, is not included in this framework, as it is meant to be a basis to inspire countries when assessing losses of biodiversity and ecosystem services. These aspects are crucial, but the framework lacks proper methodology to address them comprehensively. Therefore, these are considerations that should be looked at more closely when applying this framework in cooperation with different countries. The same holds true for cascading losses: although they are encapsulated in the framework through the understanding that the loss of ecosystem services and diverse values of nature trickle down into an entire socioecological system, concrete steps on how to assess cascading losses need to be further investigated.

Further, suggestions of concrete indicators for assessing losses based on ecosystem extent, condition/biodiversity, ecosystem services and diverse values are subject to the application of this framework. The framework presented here outlines the process to conduct an assessment of losses with varied uses of standardized methodologies, to encourage countries to utilize available data or enhance other data sources that can support loss assessments. While some examples of indicators exist and are highlighted in the overview of provided data sources ("Annex A – Data sources collection to support the assessment of climate change and disaster-related losses of biodiversity and ecosystem services"), the choice of concrete metrics and indicators depends on the specific hazard and ecosystem context in which the assessment is to be performed. This makes it challenging to suggest a universal set of indicators. Nevertheless, applying the framework in a real-world context as a next step can help elicit more concrete guidance on appropriate indicators for the proposed framework components and may result in a library of indicators for further guidance.

Finally, this framework is applicable for both climate- and non-climate-related hazardous contexts, such as oil spills or earthquakes. A large emphasis has been placed on the climate-related hazard context, given the growing role of climate drivers in ecosystem and biodiversity losses. Nonetheless, it may be worth further elaborating on these, especially regarding data sources, to more fully utilize the framework.

While this framework provides a basis for assessing climate- and disaster-related losses of biodiversity and ecosystem services, it should be subject to regular review and revision during its application, incorporating advances in science, technology and user experiences, to ensure continuous improvement and responsiveness to emerging challenges.

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