Regional Assessment on Ecosystem-based Disaster Risk Reduction and Biodiversity in South America

A report for the Resilience through Investing in Ecosystems - knowledge, innovation and transformation of risk management (RELIEF Kit) project

Convention on Biological Diversity

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Abbreviations, acronyms and symbols

ASI	Agricultural Stress Index
CAN	*Comunidad Andina*
CAZALAC	*Centro del Agua para Zonas Áridas y Semiáridas de América Latina y el Caribe, Chile*
CBD	Convention on Biological Diversity
CCA	Climate Change Adaptation
CICC	*Consejo Interinstitucional del Cambio Climático, Bolivia*
CNACC	*Comisión Nacional Asesora sobre el Cambio Climático, Argentina*
CNR	*Comisión Nacional de Riego, Chile*
DCC	*Dirección de Cambio Climático, Argentina*
DRM	Disaster Risk Management
DRR	Disaster Risk Reduction
EbA	Ecosystem-based Adaptation
Eco-DRR	Ecosystem-based Disaster Risk Reduction
ECLAC	Economic Commission for Latin America and the Caribbean
EM-DAT	Emergency Events Database
ENSO	El Niño Southern Oscillation
FAO	Food and Agriculture Organization of the United Nations
FRA	Global Forest Resources Assessment
GDP	Gross Domestic Product
GEF	Global Environment Facility
GFDRR	Global Facility for Disaster Reduction and Recovery
GHG	Greenhouse gas
GRACC	*Plan de gestión de riesgo y adaptación al cambio climático en el sector agrario para 2012-2021, Perú*
GTTGRD	*Grupo Técnico de Trabajo de Gestión de Riesgos de Desastres, Perú*
IFRC	International Federation of Red Cross and Red Crescent Societies
INAMHI	*Instituto Nacional de Meteorología e Hidrología, Ecuador*
INDAP	*Instituto de Desarrollo Agropecuario, Chile*
INDECI	*Instituto Nacional de Defensa Civil, Perú*
INEI	*Instituto Nacional de Estadística e Informática, Perú*
IPCC	Intergovernmental Panel on Climate Change
IUCN	International Union for Conservation of Nature
IWRM	Integrated water resource management
LDCF	Least Developed Countries Fund
MINAGRI	*Ministerio de Agricultura y Riego, Perú*
MMAyA	*Ministerio de Medio Ambiente y Agua, Bolivia*
MNACC	*Mecanismo Nacional de Adaptación al Cambio Climático, Bolivia*
NAP	National Adaptation Plan
NAPA	National Adaptation Programme of Action
NR5	Fifth National Report (CBD)
RIOCC	*Red Iberoamericana de Oficinas de Cambio Climático*
SAG	*Servicio Agrícola y Ganadero, Chile*
SAyDS	*Secretaría de Ambiente y Desarrollo Sustentable, Argentina*
SCCF	Special Climate Change Fund
SDG	Sustainable Development Goal
SFDRR	Sendai Framework for Disaster Risk Reduction
SENAMHI	*Servicio Nacional de Meteorología e Hidrología del Perú*
SMN	*Servicio Meteorológico Nacional de Argentina*
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNFCCC	United Nations Framework Convention on Climate Change
UNISDR	United Nations Office for Disaster Risk Reduction
UNW-DPC	UN-Water Decade Programme on Capacity Development
VHI	Vegetation Health Index
WMO	World Meteorological Organization

°C	degree Celsius
hab	habitant
ha	hectare
kg	kilogramme
km^2	square kilometre
m	metre
m.a.s.l.	metres above sea level
t	tonne

Glossary

Name	Definition
Adaptation	The process of adjustment to actual or expected climate and its effects. In human systems, adaptation seeks to moderate or avoid harm or exploit beneficial opportunities. In some natural systems, human intervention may facilitate adjustment to expected climate and its effects (IPCC, 2014a).
Adaptive capacity	The ability of systems, institutions, humans and other organisms to adjust to potential damage, to take advantage of opportunities, or to respond to consequences (IPCC, 2014a).
Climate change	Climate change refers to a change in the state of the climate that can be identified (e.g. by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings such as modulations of the solar cycles, volcanic eruptions and persistent anthropogenic changes in the composition of the atmosphere or in land use. (IPCC, 2014a). A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods (UNFCCC, 1992).
Coping capacity	The ability of people, organisations and systems, using available skills and resources, to face and manage adverse conditions, emergencies or disasters (UNISDR, 2009).
Desertification	Land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities (UNCCD, 1994).
Disaster	A serious disruption of the functioning of a community or a society involving widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources (UNISDR, 2009).
Disaster risk	The potential disaster losses, in lives, health status, livelihoods, assets and services, which could occur to a particular community or a society over some specified future time period (UNISDR, 2009).
Disaster risk management – DRM	Processes for designing, implementing, and evaluating strategies, policies, and measures to improve the understanding of disaster risk, foster disaster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life, and sustainable development (IPCC, 2012).
Disaster Risk Reduction – DRR	The concept and practice of reducing disaster risks through systematic efforts to analyse and manage the causal factors of disasters, including through reduced exposure to hazards, lessened vulnerability of people and property, wise management of land and the environment, and improved preparedness for adverse events (UNISDR, 2009).
Drought	A period of abnormally dry weather long enough to cause a serious hydrological imbalance. Drought is a relative term, therefore any discussion in terms of precipitation deficit must refer to the particular precipitation-related activity that is under discussion. For example, shortage of precipitation during the growing season impinges on crop production or ecosystem function in general (also termed agricultural drought), and during the runoff and percolation season primarily affects water supplies (hydrological drought). A megadrought is a very lengthy and pervasive drought, lasting much longer than normal, usually a decade or more (IPCC, 2014a).

Ecosystem-based Adaptation –– EbA

The use of biodiversity and ecosystem services as part of an overall adaptation strategy to help people adapt to the adverse effects of climate change. EbA aims to maintain and increase the resilience and reduce the vulnerability of people and the ecosystems they rely upon in the face of the adverse effects of climate change (SCBD, 2016).

Ecosystem-based Disaster Risk Reduction – Eco-DRR

Sustainable management, conservation and restoration of ecosystems to reduce disaster risk, with the aim to achieve sustainable and resilient development (Estrella & Saalismaa, 2013).
Decision-making activities that take into consideration current and future human livelihood needs and biophysical requirements of ecosystems, and recognise the role of ecosystems in supporting communities to prepare for, cope with and recover from disaster situations. Sustainable ecosystem management for disaster risk reduction is based on equitable stakeholder involvement in land management decisions, land-use-trade-offs and long-term goal setting (Sudmeier-Rieux, K. et al., 2013).

Ecosystem service

The benefits people derive from ecosystems. These include provisioning services such as food, water, timber and fibre: regulating services that affect climate, floods, disease, wastes and water quality; cultural services that provide recreational, aesthetic and spiritual benefits; and supporting services such as soil formation, photosynthesis and nutrient cycling (MEA, 2005).

El Niño-Southern Oscillation phenomenon –– ENSO

A complex interaction of the tropical Pacific Ocean and the global atmosphere that results in irregularly occurring episodes of changed ocean and weather patterns in many parts of the world, often with significant impacts over many months, such as altered marine habitats, rainfall changes, floods, droughts and changes in storm patterns (UNISDR, 2009).

Environmental degradation

The reduction of the capacity of the environment to meet social and ecological objectives and needs (UNISDR, 2009).

Exposure

The presence of people; livelihoods; species or ecosystems, environmental services and resources; infrastructure; or economic, social, or cultural assets in places that could be adversely affected (IPCC, 2014a).

Flood

The overflowing of the normal confines of a stream or other body of water, or the accumulation of water over areas that are not normally submerged. Floods include river (fluvial) floods, flash floods, urban floods, pluvial floods, sewer floods, coastal floods and glacial lake outburst floods (IPCC, 2014a).

Greenhouse gases

Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation of thermal infrared radiation emitted by the Earth's surface, the atmosphere itself, and by clouds (UNISDR, 2009).

Hazard

The potential occurrence of a natural or human-induced physical event that may cause loss of life, injury, or other health impacts, as well as damage and loss to property, infrastructure, livelihoods, service provision, and environmental resources (IPCC, 2014a).

Impacts

Effects on natural and human systems. In this report, the term 'impacts' is used to refer to the effects on natural and human systems of physical events, of disasters, and of climate change (IPCC, 2014a).

Landslide

A mass of material that has moved downhill by gravity, often assisted by water when the material is saturated. The movement of soil, rock or debris down a slope can occur rapidly, or may involve slow, gradual failure (IPCC, 2012).

Land-use planning The process undertaken by public authorities to identify, evaluate and decide on different options for the use of land, including consideration of long-term economic, social and environmental objectives and the implications for different communities and interest groups, and the subsequent formulation and promulgation of plans that describe the permitted or acceptable uses (UNISDR, 2009).

Mitigation The lessening or limitation of the adverse impacts of hazards and related disasters (UNISDR, 2009).

Natural hazard Natural process or phenomenon that may cause loss of life, injury or other health impacts, property damage, loss of livelihoods and services, social and economic disruption, or environmental damage (UNISDR, 2009).

Resilience The ability of a system, community or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions (UNISDR, 2009).

The capacity of social, economic and environmental systems to cope with a hazardous event or trend or disturbance, responding or reorganising in ways that maintain their essential function, identity and structure, while also maintaining the capacity for adaptation, learning and transformation (IPCC, 2014a).

Risk The combination of the probability of an event and its negative consequences (UNISDR, 2009).
The potential for consequences where something of value is at stake and where the outcome is uncertain, recognising the diversity of values. Risk is often represented as probability or likelihood of occurrence of hazardous events or trends multiplied by the impacts if these events or trends occur (IPCC, 2014a).

Risk Management The systematic approach and practice of managing uncertainty to minimise potential harm and loss (UNISDR, 2009).

Socio-natural hazard The phenomenon of increased occurrence of certain geophysical and hydrometeorological hazard events, such as landslides, flooding, land subsidence and drought, that arise from the interaction of natural hazards with overexploited or degraded land and environmental resources (UNISDR, 2009).

Storm surge The temporary increase, at a particular locality, in the height of the sea due to extreme meteorological conditions (low atmospheric pressure and/or strong winds). The storm surge is defined as being the excess above the level expected from the tidal variation alone at that time and place (IPCC, 2014a).

Vulnerability The propensity or predisposition to be adversely affected. Vulnerability encompasses a variety of concepts including sensitivity or susceptibility to harm and lack of capacity to cope and adapt (IPCC, 2014a).
The characteristics and circumstances of a community, system or asset that make it susceptible to the damaging effects of a hazard (UNISDR, 2009).

Summary

■ *By Karen Podvin and James McBreen* ■

1 Background

South America is home to approximately 18 percent of the world's population. The region cultural and natural diversity, and is home to a number of global biodiversity hotspots; with five of the 17 megadiverse countries that harbour the majority of the Earth's species located in South America. The biodiverse ecosystems provide multiple services to reduce risks from environmental hazards, support adaptation to climate change, and contribute to sustainable development.

Extreme temperatures and changing precipitation have adverse effects on agricultural, forestry and fishery productivity, the water cycle and biodiversity. Acidification of the oceans, rising sea levels, hurricanes, and changes in climate will have a severe impact on coastal livelihoods, tourism, health, food and water security. Whilst glacial melt presents a significant threat to the source of drinking water for Andean cities. The rapid population growth and displacement as well as rural economic collapse have triggered one of the fastest urbanisation rates in the world. However, agriculture, the forestry sector and fisheries contribute significantly to the livelihoods and well-being of women, indigenous and local communities, and the poor and vulnerable. Therefore, it is necessary to build the adaptive capacities of such communities who depend on ecosystem services and who are often the most vulnerable, especially with regards to food security.

The adaptive capacity of human systems in Latin America is low, particularly to extreme climate events, and vulnerability is high (Magrin *et al*., 2007). In this sense, the dependency of many countries in South America on (degrading) natural resources and the agriculture, forestry and fisheries sectors for incomes and livelihoods, combined with inadequate economic and technological development, weak governance and institutions, and rapid growth, make it a particularly vulnerable region to climate change. Climate variability further increases this vulnerability due to the increasing frequency of *El Niño* and *La Niña* events -the former responsible for a large part of the climate variability at inter-annual scales in Latin America- with impacts varying across the subcontinent (IPCC, 2007).

In the face of a changing climate and consequent increase in frequencies and magnitudes of disasters, the well-being and livelihoods of humans and ecosystems are threatened and the vulnerability of communities to natural hazards has increased.

2 The scope and purpose of this assessment

The assessment for South America provides a brief analysis of natural hazards in the region, identifies the most significant disasters by type, their occurrence and impacts -both in terms of populations affected and economic damages incurred. It incorporates information and experiences on ecosystem-based disaster risk reduction and is a first attempt to demonstrate linkages with biodiversity, from six focal countries in the region- Argentina, Bolivia, Chile, Colombia, Ecuador and Peru.[1]

Together, these countries accounted for 70% of total reported disasters in South America in the period 2000–2015, comprising 60% of floods, 84% of landslides, 74% of extreme temperatures, 55% of storms, 47% of drought, 93% of wildfire, 100% of volcanic activity, 56% of epidemics, and 96% of earthquakes in the region (Figure 1).

[1] See Annex 1 for country selection

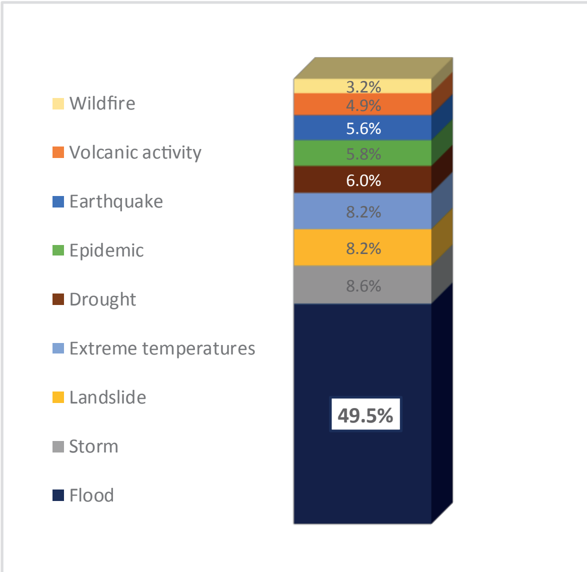


Figure 1. Occurrence by disaster type in South America, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

The assessment provides examples where sustainable management, conservation and restoration of ecosystems to reduce disaster risk have been or continue to be implemented in the region; it explores some of the ways that biodiversity and ecosystems influence DRR strategies in the region, thus contributing to sustainable and resilient development.

3 Key results

The number of climate-induced disasters has increased significantly over the last 15 years. Of all natural disasters, **floods and droughts** affect the **agriculture sector** most, illustrating the severe impact of climate-related disasters[2]. The cost of disasters in the region, both human and economic, has been increasing. In the period 2000–2015, disasters in South America caused a reported **US$ 57 billion** in total economic damages, affecting almost **74 million people**, and claiming an estimated **11,963 lives**. Economies can no longer sustain the costs of such losses and cope with such impacts on populations; therefore, we must proactively reduce our vulnerabilities and risks to disasters, having nature-based solutions as cost-effective options to tackle these major societal challenges.

Ecosystems provide multiple services to reduce risks from environmental hazards, support adaptation to climate change, and contribute to sustainable development. Healthy and functional ecosystems provide protective and hazard regulatory functions. The ecosystem-based approach is an important strategy for adaptation to climate change and disaster-risk reduction, where nature is used against climate change and hazards, whilst simultaneously providing co-benefits that can contribute to reaching these goals in a sustainable way (SCBD, 2016).

The synthesis illustrates that the experiences and policy initiatives of the focus countries represent diverse geographical areas, stakeholder groups, socio-economic conditions and strategies with DRR components, and how biodiversity and ecosystems influence them. The variety of conditions captures the richness of how different stakeholders are addressing disaster risk issues in the region, as well as the gaps and opportunities where ecosystem-based approaches can be infused in DRR options.

The main findings of the mapping exercise of Eco-DRR initiatives in the region show firstly that there are scarce cases relating specifically to Eco-DRR[3]; in several other initiatives, which focus on either climate change adaptation or mitigation and other conservation initiatives, DRR is a co-benefit (Table 1. Note: each colour is related to the main focus of each initiative). The initiatives mapped respond to hazards such as droughts,

[2] Wildfires have direct impact on biodiversity related to forest or natural vegetation fires; however, in this assessment these are not covered since the study uses the EM-DAT database, which is compiled from multiple sources, and includes disasters from 1900 to the present. The database is not exhaustive as it does not include geophysical or hydro-meteorological events not reported as causing significant losses; either because the events occurred in areas that were thinly populated at the time, or because the losses were not significant. As illustrated in Fig. 1 the occurrence of wildfires in South America, in the period of analysis 2000–2015, is 3.2%, which would imply that wildfires are perhaps one of the least reported disasters for the aforementioned reasons.

[3] Or would be needed to be mapped in a more thorough exercise.

flooding, extreme events, landslides and avalanches; among other issues, these initiatives respond to soil compaction, erosion and deforestation. The initiatives take place in a diversity of ecosystems –forests, riverine ecosystems, mountains, wetlands, agricultural and urban landscapes– and different geographical scales. The initiatives cover a range of measures either in the field –such as hydrological systems, restoration, conservation, sustainable and resilient agriculture, food security, among others. Also some initiatives focus specifically on research and assessments (or some components are focused on these), on capacity building among local stakeholders to strengthen their adaptive capacities, and policy and planning processes (Table 1). The co-benefits vary from biodiversity enhancement; traditional/ancient knowledge recovery; gender-responsive capacities; governance strengthening and planning/policy incidence; livelihood enhancement; among others.

Table 1. Examples of initiatives on Eco-DRR in the region

Examples of Ecosystem based Adaptation Disaster Risk Reduction (Eco-DRR) Initiatives						
Country	**Hazard**	**Ecosystem**	**Geographical coverage**	**Implementer**	**Initiative/Activities being implemented (years)**	**Disaster risk reduction and/or co-benefits**
Chile	avalanches, landslides	Mountain ecosystems	Biosphere Reserve Nevados de Chillán - Laguna del Laja, located in the VIII Biobío Region.	IUCN, SLF, in coordination with the Ministry of Environment of Chile (MMA).	Ecosystems Protecting Infrastructure and Communities (EPIC): Demonstrate the importance of environmental management; strengthen capacities, increase awareness and communicate about the potential on environmental management (at local, regional and national levels); disseminate through multi-stakeholder platforms, lessons learned and practical solutions which can be replicated or used as input for developing programs and public policies (2013-2017).	**Vulnerability assessment** was carried out based on local perceptions in the *Valle Las Trancas*, which identified drought, increased warming, wildfires, precipitation accompanied by strong winds, and avalanches, as the key phenomena aggravated by climate change in the Biosphere Reserve. To confront these risks, local innovations based on local knowledge, experience and capacities were proposed; among these the project promotes the **conservation and management of native forest.**
Ecuador	flooding, avalanches, landslides	Forests; wetlands	Critical forests and wetlands	Critical Forests and Wetlands to Combat Flooding - Ecuador	Flood control projects use the natural storage and recharge properties of critical forests and wetlands by integrating them into "living with floods" strategies that incorporate forest protected areas and riparian corridors.	**Protect infrastructure** from frequent disasters including **rock fall, avalanches or landslides.**
Peru	not specified, but related to glacial melt from the Andes	Urban context	El Progreso sector of Carabayllo, Lima.	Save the Children and Practical Action, in coordination with the Metropolitan Municipality of Lima and the Municipality of Carabayllo.	This urban area has been prioritised as highly vulnerable to natural disasters produced by glacial melt from the Andes, and as such the project aims to increase the resilience of the inhabitants.	The project focuses on *Chillón* River, and **investigates risk and proposes risk reduction strategies in this urban context.**
Argentina	flooding, avalanches, landslides	forest, river ecosystem	Forest protected areas and riparian corridors	Critical Forests and Wetlands to Combat Flooding.	Flood control projects which use the natural storage and recharge properties of critical forests and wetlands by integrating them into "living with floods" strategies that incorporate forest protected areas and riparian corridors.	**Protection forests** form part of DRR strategies and serve to protect infrastructure from frequent disasters including **rock fall, avalanches or landslides**

Bolivia	flooding, drought	Amazon plain and gallery forests	Fallow land in the basin of the Mamoré River ––in the San Ignacio de Moxos Municipality, in the Beni Department	Bolivia's Ministry of Environment and Water (MMAyA)	*Waru Waru* was used for risk management, CCA, improving food security, and strengthening the livelihood options for local population. The project revived an ancestral system of cultivation and irrigation, forming a patterned system of raised cropland and water-filled trenches.	This system captures water when there are droughts and drains away water when there is too much rain, which allows crops to be effectively irrigated all year round and acts as an important **buffer to ecosystems and communities in times of flash flooding**; improved income opportunities for communities by promoting crop production in periods of flood and drought, and also **promotes CCA and DRR by floods and drought in communities**.
Bolivia	not specified	Mountain ecosystems	In six departments: *La Paz, Oruro, Cochabamba, Chuquisaca, Potosí* and *Tarija*	Swiss Cooperation	DRR project for prevention, to build awareness and strengthen DRR capacities for communities and organisations.	One of the project components focused on reducing climate risks in agriculture, which promoted the application of **agroecology practices for prevention, mitigation and adaptation.**

Examples of Climate Change Adaptation initiatives with Eco-DRR co-benefits

Ecuador	drought	Agricultural landscapes, forests	*Azuay, Loja, Manabí, Morona Santiago* provinces.	Ministry of Environment, UNDP	Climate Change Adaptation through an effective water governance project (PACC): reduce climate change vulnerability in Ecuador, through the efficient use of water resources (2006-2014).	36 community-level projects focused on agroecology and forests, with the **recovery of ancient knowledge and practices to ensure enough water resources** now and in the future.
Bolivia	extreme events, drought	Mountain ecosystems	Department of La Paz, in the Municipalities of Batallas and Palca.	World Bank, CARE, and the Swiss Cooperation in the eastern Andes	Adaptation to the impacts of Andean Glacier retreat (PRAA for its acronym in Spanish); DDR for Climate Change Adaptation pilot activities in the two municipalities.	**More resilient crops**, likely linked to plant genetic diversity and therefore serve as a good **example of the role of biodiversity in DRR.**
	extreme events, drought	Mountain ecosystems	Cintis; and Andean zone of the Department of Cochabamba	*Fundación Agua Tierra Campesina (ATICA)*	Reducing disaster risk and CCA, through the strengthening of local governance in the municipalities forming the Commonwealth of Cintis.	The **capacities of women groups** were also strengthened to confront climate change impacts in the Andean zone of the Department of Cochabamba.
Peru	drought	High Andean wetlands and puna grasslands	Lima Region, Yauyos Province in the high basin of the Cañete River, characterised by high Andean wetlands and puna grasslands.	Patronato-Nor Yauyos Cochas Landscape Reserve, IUCN-Sur, *Universidad Católica* Sedes Sapientiae and the RPNYC	Study to understand current capacity and potential for capturing and storing water in the upper Cañete river basin: This initiative aimed to establish baseline conditions of water storage capacities of the bofedales and pajonales, as part an integrated water management strategy in the basin, to increase climate resilience of the socio-ecological system.	**Identify critical areas for restoring water storage capacity and restore the capacity** of the bofedales and pajonales to capture and store rainwater through: a) Establishing a baseline of the natural area from 1962; b) Implementing two restoration parcels (bofedales and pajonales) in 17 ha of land with farmer communities in Huancaya.
Peru	extreme events, drought, fires (in one community)	Mountain ecosystems	Nor Yauyos-Cochas Landscape Reserve (NYCLR) in the Peruvian Andes (Junin and Lima regions)	TMI and IUCN (as part of the Mt. EbA project, implemented also with UNDP and UNEP)	Implementing no-regret EbA measures to reduce the vulnerability and increase resilience of 2 local communities and ecosystems (Canchayllo and Miraflores)	Faced with the degradation of grasslands and one of the main climate vulnerabilities related to extreme events and droughts, two communities in the Nor Yauyos-Cochas Landscape Reserve, developed adaptive land practices that focus on the **enlargement and conservation of wetlands and community-based management of native grasslands**, as part of no-regret EbA measures. In one of the communities, the increased humidity as result of the measures supports prevents wildfires.

Colombia	not specified	Mountain ecosystems (glaciers, high Andean forests and *páramos*)	Policy processes at the national level, as well as in specific sites such as in the Chingaza Massif.	Institute of Hydrology, Meteorology and Environmental Studies (IDEAM) and CI-Colombia supported the development of INAP, which focused on high mountain ecosystems	Integrated National Adaptation Plan (INAP), in line with the promotion of EbA approaches and policy interventions to address climate change impacts. IDEAM generated knowledge of ecological and climate processes at national level, as well as local scales such as in the Chingaza Massif (ended in 2011).	In the Chingaza Massif, a number of EbA measures were implemented, including the identification and implementation of **ecosystem management actions to increase ecosystem resilience and reduce vulnerability of both farming systems and local human communities**. Projects are **embedded into national, regional and local policy making efforts and spatial planning.**
Colombia	not specified	dry forest, gallery forest, and the aforementioned agricultural lands	*Arroyo Carolina* micro-watershed, located in the *Planeta Rica, San Carlos* and *Pueblo Nuevo* Municipalities, in the Department of *Córdoba*.	*Fundación Humedales*, with the *Corporación Autónoma Regional de los Valles del Sinú* and *San Jorge-CVS*	Management plan for the *Arroyo Carolina* micro-watershed.	Different uses of the watershed were identified and mapped, with an associated **vulnerability analysis** and management plan oriented towards CCA. The management plan detailed **relevant mitigation measures designed for each land-use type and risk**; these measures were associated specifically with the restoration and recovery of ecosystems present in the watershed.
Colombia	not specified	Andean mountains	*Lagunas de Fúquene*, *Cucunubá* and *Palacio*–-, located in the *Altiplano Cundiboyacense*, between the departments of Cundinamarca and *Boyacá*.	*Fundación Humedales*	Vulnerability assessment and adaptation strategy for a wetland complex in the highlands on the Eastern Cordillera of the Colombian Andes.	**Vulnerability assessment and adaptation strategy** through fieldwork, historical climate and hydrological data, land cover maps, workshops and interviews with local and regional stakeholders relevant for the management and use of ecosystem services derived from the lagoons in the *Valle del Río Ubaté*.
Ecuador	not specified	*Páramos*	*Páramos* of Chimborazo / *Chorrera* Mirador and *Pulinguí San Pablo*	*ECOPAR*	Addressing Food Security: traditional knowledge for adapting productive systems to climate change – Ecuador: Strengthen capacities of local stakeholders for the planning and application of CCA measures in the páramos of *Chimborazo*; through the promotion of policies and strategies that contribute to the conservation and management of páramos, based on ecosystem-based management with an emphasis on local nature-based solutions to CCA. / Sustainable livestock production, which included: pastures improvements and the incorporation of windbreaks to reduce vulnerability of pastures to frost and strong winds prevalent in the area.	These **conservation strategies** play an important role in preserving the fragile páramo ecosystem, and the agricultural and ecological systems on which the livelihoods of local communities depend. Fundamentally, they also contribute to **CCA and DRR for both agroecosystems and households.**

Ecuador	flooding, drought	Riverbanks; wetlands; *páramos*	Andean páramos and forest; *El Ángel* watershed, Ecological Reserve *El Ángel* region, in the northern Andes of Ecuador.	*Corporación Grupo Randi Randi*	Inclusive and sustainable watershed management for CCA – Ecuador: To promote sustainable livelihoods and reduce the threat of natural disasters such as floods and drought, CGRR is using a coordinated and participatory approach, involving communities, public sector, and civil society and non-governmental organisations to support food security and build resilience to disasters and climate change.	**Adaptation measures and conservation of ecosystem services in the watershed**. Implementation of activities incorporated into land-use management plans to protect riverbanks and wetlands in territories within the Ecological Reserve *El Ángel*. In addition to a study to assess the impact of climate change on principle crops in the lower/medium *El Ángel* watershed. A **climate change vulnerability assessment** was carried out in a key irrigation area in *Pueblo Viejo*, and **capacities strengthened** for members of the irrigation consortia. Eco-DRR can be integrated into watershed development planning.
Bolivia	Soil compaction and erosion	Amazon plain and gallery forests	Amazon plain and gallery forests in the *Santa Ana del Yacuma* Municipality, in the Beni Department, north-eastern Bolivia	Amazonia Services	Sustainable productive development and CCA, with the re-introduction and promotion of an ancient system of soil management (Waru Waru), to protect against soil erosion of the Amazon plain and gallery forests; using traditional knowledge to improve the quality of livelihoods and strengthen community resilience, as well as improve water management techniques and natural resource conservation.	**Traditional irrigation technique includes improved soil management**, which has increased soil stability and soil biodiversity, thereby a) reducing soil compaction and erosion; b) **increased productivity and carbon sequestration**; c) contributing to the **conservation of valuable ecosystem services** and d) promoting **food security** by diversification of productivity through the use of plant genetic resources for food and agriculture.

Examples of Climate Change Mitigation initiatives with Eco-DRR co-benefits

Colombia	not specified	swamps, gallery forest and flooded forests	The basin is located in *Vichada* Department, and covers moriche palm swamps, gallery forest and flooded forests.	The Corporación Ambiental La Pedregoza, in partnership with the Alexander von Humboldt Research Institute	The project ––CO2 Tropical Trees––, promotes improvement of certain land use practices with the introduction of silviculture in the *Río Bita* basin	**Compensation scheme focusing on tree planting** for carbon sequestration, covering natural forest and savannah ecosystems
Peru	flooding	River ecosystems	Native Awajun community 'Shampuyacu' in the *San Martín* region in the Peruvian Amazon	IUCN, AIDER, *CI-Perú*	REDD+: Supporting countries and communities to design schemes for benefit sharing': pilot 'REDD+' activities within CI's Conservation Agreement framework have been implemented, among these, restoration of riparian ecosystems to promote sustainable river basin management has taken place.	**Riparian vegetation has been maintained** (from an initiative that took place in mid-2013 before this project) and expanded, with **increased vegetation cover and protecting crops from river bank erosion and flooding** when river levels increase, as well as increasing **biodiversity**.
Peru	Deforestation	Tropical montane forest	Tropical montane forest in the *San Martín, Ucayali, Huánuco*, and *Loreto* Departments	The Centre for Conservation, Investigation, and Management of Natural Areas (*CIMA – Cordillera Azul*), and the National Service of Natural Areas Protected by the State (SERNANP)	PNCAZ National Park Programme: protect a variety of species, biological communities, and geological formations pertaining to the montane forest of the *Cordillera Azul*; as well, as support the development of an integrated and sustainable management of natural resources in the buffer zone	**Conservation of more than 1.3 million ha of intact montane forest, and its biodiversity**, the project aims to prevent deforestation in the PNCAZ, and to **reduce emissions by more than 17 million tCO2e over 10 years. Strengthening local environmental management strategies**, to build local capacity for sustainable land use and to improve the quality of life of communities inside the buffer zone.

Examples of conservation initiatives with Eco-DRR co-benefits						
Colombia	not specified	high mountain ecosystems	Western Andes in Colombia	Department of National Parks	Ongoing zone management system in the high mountain landscapes of the Western Andes in Colombia.	Implicit to this work, is the definition of activities relevant for the risks identified for each zone; which include **restoration, population management and regulation of access.**
Colombia	not specified	dry forest	Ituango Municipality, Department of Antioquia	Alexander von Humboldt Research Institute of Biological Resources, along with public companies from *Medellín* and the Autonomous Corporation of Antioquia	Restore highly degraded dry forests.	The **restoration** activities are envisioned to compensate environmental harm caused by the construction of a reservoir, and to contribute to the **conservation of the fragile dry forest ecosystem** of the area. Three pilot projects will restore 17,000 ha of forest landscape, which serves as a reference for compensation.
Argentina	flooding, drought	river ecosystem	Drainage basin of the Uruguay River; which, together with the Paraná River, forms the *Río de la Plata* estuary	Private Nature Reserve Network	Creation of a network of private nature reserves for the conservation of the riparian vegetation and important grassland areas; main activities include: protected area planning and management, biodiversity monitoring and environmental education.	**Restoration of freshwater wetlands** offe**r protection to life and property** from flooding and drought in the River Uruguay drainage basin
Argentina	flooding	River ecosystems, flood plain, islands (*Islas del Paraná*) and the pre-delta	“El Pozo” Ecological Reserve (also known as the University City Ecological Reserve) is located in the Paraná river basin in the Santa Fe province, northeast Argentina	*Fundación Hábitat & Desarrollo and the Universidad Nacional del Litoral*	Conservation of biodiversity and restoration of the river ecosystem, which, through the promotion of healthy ecosystem function, are both significant in terms of reducing disaster risk. The restoration of lotic ecosystem vegetation affected by the great flood in 1993, protected area planning and management, biodiversity monitoring, environmental education and fire control.	The river and its wetlands are a water resource for livestock farming, agriculture, fisheries and transport. The importance of river restoration to recover river conditions in order to **reduce flood risk** and **improve water quality is fundamental**.

Source: own elaboration, based on surveys and desk research.

4 Key challenges and opportunities to promote Eco-DRR in the region

With the analysis of the diverse benefits that ecosystem-based solutions represent for more comprehensive DRR activities, and the previous examples to illustrate these, there are still many challenges for them to become mainstreamed into policies and practice, as well as several opportunities at the policy, implementation (evidence) and knowledge level (Table 2), see more details in the challenges and opportunities section in Chapter 5.

Table 2. Summary of the key challenges, opportunities and recommendations to promote ecosystem-based approaches for DRR in South America

Challenges to scale-up Eco-DRR and integrate biodiversity in the region	▪ South America experiences significant impacts of natural hazards and disasters which significantly affect biodiversity and agriculture (one of the main livelihoods in the region). ▪ There is a need to strengthen the inter-sectoral and multi-stakeholder efforts for mainstreaming Eco-DRR within the disaster risk management strategies, as well as effective enabling conditions for this. ▪ There is a need to ensure a solid case in favour of ecosystem-based approaches for CCA and DRR, including the need to make an economic case for decision making. ▪ There is a need for greater investment in Eco-DRR to build resilient livelihoods and food production systems, as well as overcoming the barriers in multi-sectoral public funding for climate change. ▪ Eco-DRR does not lend itself to easy identification of measurable targets or goals; thus the existence of data gaps represents a significant challenge. ▪ There are capacity and knowledge gaps in ecosystem based approaches for CCA and DRR, as well as a lack of recognition and capacity on the role of biodiversity and DRR amongst civil society, and especially local communities.
Opportunities to scale-up Eco-DRR and integrate biodiversity in the region	▪ There are existing Eco-DRR and EbA initiatives and strategies in the region, these provide valuable evidence and lessons learnt, and serve as a solid foundation on which to build; however, these initiatives and strategies are often not named as such. ▪ There is enormous scope for integrating Eco-DRR initiatives into biodiversity elements of risk reduction; as there is also much supporting evidence in the region of policies and legislation for biodiversity conservation especially relevant for DRR. ▪ The EbA approach is already either integrated or has much potential to be integrated and up-scaled within overall adaptation and DRR strategies (which are already underway in countries of the region). ▪ Nature-based solutions including ecosystem management and biodiversity conservation generate multiple benefits besides DRR; ecosystem-based approaches for mitigation and adaptation provide collateral benefits for DRR.

Recommendations to scale-up Eco-DRR and integrate biodiversity in the region	▪ Promote and strengthen inter-sectoral and multi-stakeholder/ multidisciplinary efforts and the enabling conditions for mainstreaming Eco-DRR. ▪ Clarify and adapt institutional frameworks to articulate and facilitate collaboration among different institutions related to environment and DRR. ▪ Gather and systematise experiences and arguments in favour of ecosystem-based approaches for CCA and DRR, including economic assessments that will make a stronger case for decision making and investment. ▪ Raise awareness and infuse the ecosystem-based approaches for CCA and DRR among governments, civil society (including local communities and conservation and development practitioners), academia and public sector. ▪ Rigorous DRR based on biodiversity should include cross-sector coordination to prioritise conservation interventions through the assessment of threats to biodiversity and natural ecosystems ▪ Generate and share solid evidence and cost-effectiveness of ecosystem-based approaches among diverse stakeholders.

Source: Own elaboration based on Chapter 5.

1 Introduction

Over the last decade, 700,000 people lost their lives, over 1.4 million were injured, and around 23 million were made homeless, as a result of disasters. Population growth, environmental degradation and climate change will likely exacerbate disaster impacts in many regions of the world. As such, with the increasing incidence and severity of geophysical[4] and hydro-meteorological[5] hazards, it is critical to identify opportunities for effective Disaster Risk Reduction (DRR) strategies.

Climate change is leading to more frequent and more severe natural catastrophes such as floods, extended periods of drought, and storms, while ecologically relevant climate variables are projected by the Intergovernmental Panel on Climate Change (IPCC, 2013), to increase dramatically over the next century, the effectiveness of traditional approaches to disaster risk reduction is likely to become increasingly strained as the rate and severity of climate-driven impacts grow.

Extreme events that often impact water availability, fisheries, landslides and forest fires, often have profound effects on people's lives where for instance, smallholder farmers may lose their livelihoods due to weather-related crop failures. However, such impacts extend beyond the individual, affecting the economic situation of entire countries. In addition to these social and economic effects, existing threats to biodiversity, and therefore current conservation efforts, are likely to also be exacerbated, disrupting important ecological processes, and causing drastic changes in species ranges as a consequence of increasingly inhospitable climatic conditions.

4 Geophysical events include earthquakes, volcano eruptions, tsunamis, dry mass movements.
5 Hydro-meteorological events include storms, floods, wet mass movements.

Whilst disasters often follow natural hazards like earthquakes, floods, droughts and cyclones, DRR aims to reduce the damages caused by such hazards through an ethic of prevention. Therefore, DRR focuses on risk management that can avoid a natural hazard turning into a disaster, which is primarily dependent on how a society can cope with impacts so building the ability to reduce such risks and strengthening coping capacities. Disaster risk management aims to avoid, lessen or transfer the adverse effects of hazards through activities and measures for prevention, mitigation and preparedness (UNISDR, 2009).

There is increasing evidence that nature is a vital component of cost-effective DRR strategies. Ecosystem-based Disaster Risk Reduction (Eco-DRR) can be understood as the *sustainable management, conservation and restoration of ecosystems to reduce disaster risk, with the aim to achieve sustainable and resilient development* (Estrella & Saalismaa, 2013).

Well-managed ecosystems, such as wetlands, forests and coastal systems, act as natural infrastructure, reducing physical exposure to many hazards and increasing the socio-economic resilience of people and communities by sustaining local livelihoods and providing essential natural resources such as food, water and building materials. The services provided by ecosystems contribute to building resilience, helping recovery after a disaster, and include the provision of food, fuel and clean water during emergencies. Therefore, effective ecosystem management not only offers an opportunity to strengthen natural infrastructure and human resilience against natural hazards, but also generates a range of other social, economic and environmental benefits for multiple stakeholders, which in turn feed back into reduced risk.

In a climate-altered future, where change is constant and inevitable, there will be much uncertainty about the rate, magnitude, and direction of changes for natural systems in the region, thus there is a need for a long-term and strategic vision for DRR. Certainly, biodiversity conservation planning over larger biogeographical scales and across multiple political and institutional jurisdictions could play a fundamental role in this. In many ways, South America possesses a unique opportunity in this regard, as it boasts an array of political and institutional instruments that can contribute in achieving this goal.

This Regional Assessment is a component of the Resilience through Investing in Ecosystems - knowledge, innovation and transformation of risk management (RELIEF Kit)[6] Project (also developed in five other regions), and sets out to provide an overview of the situation of disaster risk in South America, as well as document the role of biodiversity and ecosystems in DRR. In an effort to strengthen capacities for Eco-DRR implementation, this assessment will contribute to the generation of knowledge on the importance of biodiversity and ecosystems in Eco-DRR approaches at national and the regional level. The results will inform capacity needs, national and regional policy coherence opportunities amongst key sectors such as disaster management, climate change, development and conservation as well as provide a basis to build actions and initiatives on.

The present assessment represents a first step in synthesising some of the innovative approaches to ecosystem management in the face of some of the most prevalent natural hazards present in South America (flooding, storms, drought, sea-level rise, wildfire, earthquakes and volcanic eruptions). It also presents information on institutional capacity building and collaborative projects in South America that integrate biodiversity conservation, ecosystem management, DRR and climate change adaptation (CCA).

6 https://www.iucn.org/about/work/programmes/ecosystem_management/disaster/solutions/relief_kit_project/

2 Methodology

The preparatory phase initiated with a revision of secondary information sources, beginning with background material to contextualise central topics for carrying out the South American regional assessment on biodiversity and DRR, and its scope in relation to the RELIEF Kit Project. Principal sources of background literature include the Convention on Biological Diversity (CBD) global synthesis on ecosystem-based approaches for climate change adaptation and DRR, which also provided useful methodological guidance to conduct the assessment for South America, and to maintain coherence with the other five regional assessments developed for the RELIEF Kit Project.

A matrix was prepared to facilitate selection of focal countries in the region (Annex 1). The key criteria used for final country selection included: i) Previous work on CCA initiatives with IUCN-Sur (and partners) in the last five years; ii) Previous work specifically on Eco-DRR with IUCN-Sur within the last five years; iii) Presentation of Countries' Fifth National Reports to CBD; iv) Institutions working in DRR (with links to ecosystem management); v) Feasibility to revise information regarding country size; vi) Vulnerability to disasters by natural phenomena. An analysis of the twelve South American countries in terms of vulnerability to natural hazards was carried out (Annex 2) as part of this last criterion. Due to the necessity to use data that allowed for comparability between countries, and the time constraints of this assessment, the Emergency Events Database (EM-DAT) maintained by the Centre for Research on the Epidemiology of Disasters (CRED)[7] was used, as it is widely considered the most comprehensive, publicly available global database on natural hazards and their impacts.

7 http://www.emdat.be/

The final country selection matrix identified Argentina, Bolivia, Chile, Colombia, Ecuador and Peru as the six focus countries for the Regional Assessment. However, the assessment aims to provide information and recommendations on Eco-DRR that can also be useful for the other six countries in the region (i.e. Brazil, Guyana, Paraguay, Suriname, Uruguay, and Venezuela).

The collection of reliable data and information considered two main but equally important methods. As mentioned above, secondary data sources provided important background particularly on the state of the region and the focus countries in terms of vulnerability to disasters and biodiversity. Whilst primary data and information was key to corroborate the existence of ecosystem management initiatives in focus countries as a tool for reducing damage by natural hazards.

The literature review of official national and local biodiversity and disaster risk management and adaptation strategies included: National Reports to the CBD, National Biodiversity Strategies and Action Plans (NBSAPs), National Disaster Management Plans, National Adaptation Plans, National Adaptation Programmes of Actions (NAPAs), project documents and reports/case studies, scientific articles and news articles.

The core of the empirical effort was based on the standardised survey, conducted during February 2016, with the objective of obtaining first-hand insights into Eco-DRR experiences in the region, whilst also corroborating existing secondary source information.

The survey outline (used as a basis for all regional assessments of the RELIEF Kit Project) was translated into Spanish, adapted to the regional context, and uploaded into an online survey format in SurveyMonkey (see Annex 5). This facilitated various aspects of the primary information gathering component, especially in terms of efficient distribution and return times, greater convenience for experts working in conservation and DRR related topics in government institutions and other relevant organisations. An additional benefit of using the online survey format is that it streamlined the analysis, making results available as soon as the stakeholders responded to the survey.

Once completed, the collated information from the online survey was organised into key thematic areas related to biodiversity, ecosystems and conservation approaches to DRR in a database to facilitate country-specific data recording and recall, as required according to the different stages of the analysis. In terms of the policy and institutional analysis in the focus countries, in addition to valuable insight from the survey results, national policy documents and documentation on considerations of DRR and biodiversity were reviewed, including the policy and institutional context for EbA and DRR from the CBD global synthesis report, official government websites, etc.

The following keywords were used for the literature review:

- Natural hazards (floods, storms, drought, wildfire, earthquakes, hurricanes, desertification, tsunamis, sea level rise, landslides, avalanches, land degradation)
- Disaster (risk, reduction, vulnerability, adaptation, adaptive capacity)
- Ecosystems (coastal/marine, drylands, mountains, forests, wetlands, mangroves, rivers / river basins / watersheds)
- Other common keywords: climate change, adaptation, resilience

The identification of key stakeholders represented an important precursor to the survey, specifically in terms of ensuring relevant stakeholder engagement from focus countries, thereby maximising the potential for obtaining accurate and up-to-date information, and permitting the most efficient use of time and resources. Here, the regional presence of IUCN, its partners, and related national organisations in focus countries proved key to ensuring a solid stakeholder mapping. The most relevant stakeholders identified included government agencies working in DRR related areas: environmental sector, development planning, security, and infrastructure; as well as national organisations working with environmental management, conservation and DRR.

The survey was sent to approximately 350 contacts —including IUCN Members and Commission on Ecosystem Management (CEM) and World Commission on Protected Areas (WCPA) members in Argentina, Bolivia, Chile, Colombia, Ecuador and Peru–– selected according to their respective affiliation to either the DRR (where possible, Eco-DRR), natural resource management, conservation community in their respective country and/or the South American region.

These key stakeholders were identified through their respective conservation, development and humanitarian organisations, related ministries and public institutions, as well as international donor and scientific institutions. Of the 31 experts who responded to the survey – Argentina (13%), Bolivia (7%), Colombia (28%), Chile (1%), Ecuador (28%), and Peru (23%) – most belong to research institutions, followed by development organisations, and public disaster risk management organisations. Other experts came from humanitarian organisations that often have close links to both development and disaster risk organisations.

The stakeholder matrix (Annex 3) provides a detailed list of the names of the experts and their affiliation to relevant institutions, which includes government agencies working in DRR related areas: environmental sector, development planning, security, and infrastructure; as well as NGO, CSO, INGO, multilateral organisations, as well as the private sector and scientific institutions working with environmental management, conservation and DRR. This database is in no way intended to be exhaustive, but instead presents initial stakeholder information for each focus country, which will serve as an important tool for the collection of primary data and information, and for future initiatives within the RELIEF Kit Project.

In summary, the results of this Assessment are based on a literature review and standardised survey with a focus on key experiences from the six focus countries. The revision of assessments and strategic documents from the CBD and other relevant country initiatives, enabled the identification of case studies related to biodiversity, ecosystems and conservation approaches to DRR. These in turn, served as an important input for understanding and preparing a preliminary synthesis of country vulnerability, identifying types of natural hazards, ecosystems and biodiversity in the region.

Environmental context

Geography

South America, occupying the southern portion of the Americas, is bordered to the north and northwest by the Caribbean Sea, the Pacific Ocean to the west, and the Atlantic Ocean to the north and east (Figure 2). Its territorial extension of 17,840,000 km^2, is equivalent to roughly one-eighth of Earth's land surface, and includes twelve sovereign states – Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Guyana, Paraguay, Peru, Suriname, Uruguay and Venezuela – and two non-sovereign states – French Guiana and the Falkland Islands[8].

Topography

The topographic relief in South America is dominated by the Andean cordillera – the highest tropical snow-covered mountains in the world – stretching about 9,000 km along the Pacific Coast, across seven countries encompassing Argentina, Chile, Bolivia, Peru, Ecuador, Colombia and Venezuela. The Andes are created primarily by the convergence of the Nazca and South American tectonic plates. Another zone of plate convergence occurs along the north-western coast of South America where the Caribbean Plate also slides under the South American Plate and forms the north-eastern extension of the Andes Mountains (as seen by the topographic relief map in Figure 3).

Figure 2. Map of South America
Source: Own elaboration

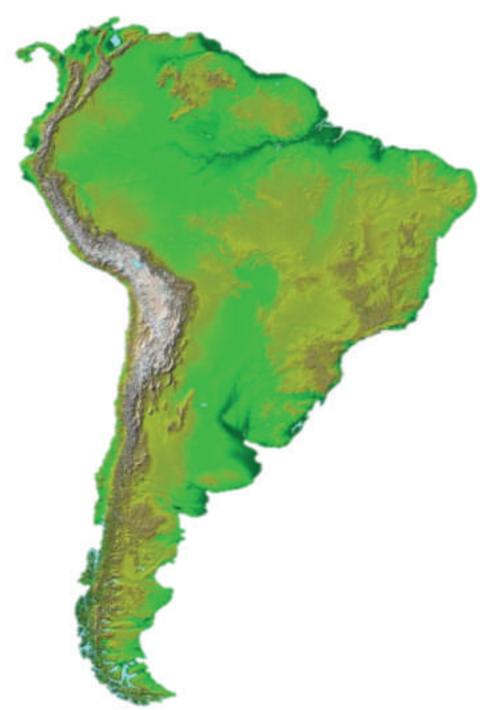


Figure 3. Topographic relief in South America
Source: NASA (2003)

8 A dispute exists between the governments of Argentina and the United Kingdom of Great Britain and Northern Ireland concerning sovereignty over the Falkland Islands (Malvinas).

The Andes host significant glaciers and volcanoes, as well as a number of high plateaus, which, today are home to the region's largest rural population. Indeed, the majority of the population in the subcontinent live near the western or eastern coasts while the interior and the far south are sparsely populated. The Andes play a vital role in the water supply of both the Amazon and Pacific coastal river basins. The South American region represents a significant source of freshwater for the many watersheds in the region, with the Amazon, Orinoco and Río de la Plata Basins: three of the biggest hydrographical areas on Earth. East of the Andes, much of northern South America drains into the Amazon River, the world's largest river in terms of both watershed area and flow volume.

North of the Amazon, the Guiana Highlands stand in sharp contrast to the surrounding lowlands, indeed hosting the world's tallest waterfall, Angel Falls (979 metres). To the southwest, broad lowlands host the Gran Chaco and Pampas regions.

The most important freshwater wetlands are those of El Pantanal (Brazil) and Iberá (Argentina); associated with Río de la Plata basin, which embraces approximately 5 million km^2. Integration with the Orinoco (70,000 cubic metres per second – m^3/s) and Amazonas (180,000 m^3/s) basins makes this area the largest running surface-water system in the world (329,400 m^3/s), accounting for approximately 35% of global runoff and covering an area of about 12 million km^2 (IPCC, 2014b).

Climate

The orographic barrier represented by the Andes, in addition to the large oceans surrounding the subcontinent greatly influence both climate and land-use patterns in South America.

As illustrated in Figure 4, there are three dominant climate types by land area, these are: tropical (60.1%), followed by temperate (24.1%) and arid (15.0%). The Polar climate type (0.8%), on the other hand, occurs twice in the tropics and temperate Andes, due to the high elevation; and in the southern cordillera as well as in the Falkland Islands and South Georgia.

Figure 4. Koppen-Geiger climate type map of South America.
Source: Peel et al. (2007)

Hydrology and water resources

About 35% of the world's continental waters are found in South America, but the distribution within and among countries is highly variable (Figure 5). Many areas like north-eastern Brazil, coastal Peru, and northern Chile have difficulty meeting their water needs. About two thirds of South America is arid or semi-arid, including large areas of Argentina, Bolivia, Chile, Peru, north-eastern Brazil, Ecuador and Colombia. Wetlands are distributed throughout the region but are more extensive in the tropical and subtropical areas.

The region contains three of the largest river basins in the world: the Amazon, Orinoco and Rio de la Plata. It also boasts the Guarani aquifer, one of the world's largest groundwater bodies, extending to more than 1,200,000 km^2 (Global Water Partnership, n.d.). Therefore, these forested catchments offer significant accessible freshwater for the region.

Figure 5. Hydrological Basins of South America
Source: FAO (2011)

Figure 6. Rivers in South America
Source: FAO (2014)

Whilst global warming threatens water resources through increased glacial melt in the region, deteriorating water quality is prevalent due to deforestation and soil erosion. In the Amazon region, land clearance, forest fires, and fragmentation present the greatest threats. The Global Water Partnership estimate that over the next 35 years, between 30% and 60% of the Amazon rainforest could be abruptly and irreversibly replaced by a type of dry savannah, with the consequential large-scale loss of livelihoods and biodiversity, and the related water quality declines associated with the decrease in forest condition and cover. These impacts will likely be perpetuated by natural hazards such as floods, landslides, and soil erosion.

The important river systems present in South America, as illustrated in Figure 6, could be adversely affected by climate change and mismanagement of associated ecosystems, particularly further deforestation and, inter alia, deterioration of the buffer capacity of inland wetlands.

In terms of coastal ecosystems, as visualised in Table 3, South America has a total of 31,079 km of coastline. Only two countries —Bolivia and Paraguay— are landlocked, the other ten countries possess rich coastal ecosystems. Such an extensive coastline also implies equally extensive low-lying coastal areas liable to floods, storm surges and rising sea levels, etc. South America boasts unique biological and cultural diversity, tropical glaciers and fragile ecosystems, including arid and semi-arid areas liable to floods, drought and desertification.

Table 3. Coastline in South America. *Source: CIA (2015)*

Country	km
Argentina	4,989
Bolivia	0 (landlocked)
Brazil	7,491
Chile	6,435
Colombia	3,208
Ecuador	2,237
Guyana	459
Paraguay	0 (landlocked)
Peru	2,414
Suriname	386
Uruguay	660
Venezuela	2,800
Total	**31,079**

Ecosystems

South America is characterised, in part, by its world-leading levels of biodiversity. All of the world's major types of ecosystems are present in the region. Venezuela, Colombia, Ecuador, Bolivia, Brazil and Peru are among the richest countries in terms of plant and animal species. The Neotropic ecological zone includes the tropical terrestrial ecoregions of the Americas and the entire South American temperate zone. The global ecological zoning for the global forest resources assessment proposes the division of the subcontinent's land surface into ecological zones as illustrated in Figure 7. These biogeographic divisions are based on distributional patterns of terrestrial organisms, where organisms have evolved in relative isolation, separated by geographic features. Such barriers to migration as those presented by the Andes mountains or the driest non-polar desert in the world, the Atacama Desert, a 1,000-kilometre plateau on the Pacific coast, west of the Andes. The ecoregions indicate general groupings of organisms based on their shared biogeography, and corresponding to the floristic kingdoms of botany or zoogeographic regions of zoology.

Figure 7. Global Ecological Zones in South America
Source: FAO (2012)

Table 4 provides a more detailed look at each of the Global Ecological Zones in South America.

Table 4. Global Ecological Zones (GEZ) in South America

Global Ecological Zone		Surface Area		
		km^2	% of total land area Region	% of GEZ world total
Tropical	Rainforest	6,631,240	37.3	45.5
	Moist deciduous forest	4,302,306	24.2	38.9
	Dry forest	1,681,596	9.5	22.5
	Shrubland	103,034	0.6	1.2
	Desert	137,638	0.8	1.2
	Mountain systems	1,886,495	10.6	41.7
Subtropical	Humid forest	1,199,948	6.8	25.6
	Dry forest	100,504	0.6	6.3
	Steppe	639,738	3.6	13.0
	Desert	0	0	0
	Mountain systems	238,162	1.3	4.9
Temperate	Oceanic forest	259,147	1.4	14.4
	Continental forest	0	0	0
	Steppe	498,298	2.8	8.5
	Desert	0	0	0
	Mountain systems	76,895	0.4	1.1
Total land area		17,755,001	99.9	

Source: Own elaboration based on FAO (2012)

Forests

Forest biomes in the region include tropical rainforests like the Amazon and the Mata Atlantica in Brazil. Other tropical deciduous forests can be found in the Pacific watershed of Ecuador, in Venezuela, and on the Brazilian coast from about 7°S to the Tropic of Capricorn. Mid-latitude deciduous or temperate forests are located on low elevation coastal mountains in southern Brazil, southern Chile and southern Argentina. It is possible to find Austral forests on the southernmost tip of the continent and on Tierra del Fuego Islands (ESA, n.d.).

Tropical forests make up about 40% of the world's forested area and contain about 60% of global forest biomass. Forests occupy approximately 22% of South America, and represent about 27% of the world's global forest coverage. Forests in the region represent an important economic resource, both for trade and subsistence. They play an important role in the carbon budget and in the economy of the region.

Using the Vegetation Index, the European Space Agency have created the vegetation density map for South America (Figure 8), which illustrates where flora is thriving (green areas), and where it experiences most stress due to lack of water (cream and beige area).

Along with the megadiverse countries in the region, which boast high numbers of endemic species, some of the countries in South America are experiencing alarming levels of habitat conversion. In this sense, the conversion of tropical forest into other land use often has consequences on climate, increasing surface and soil temperatures, creating diurnal temperature fluctuations and reducing evapotranspiration. Large-scale forest clearing could have negative consequences, such as the reduction in runoff of the Amazon River system. Such consequences weaken the integrity of the ecosystem and livelihoods related to it, leaving it more susceptible to impacts of natural hazards.

Deforestation of the Amazon rainforest is having a negative impact on the planet because it reduces rainfall and provokes runoff losses, reducing water input in various regions such as Brazil, Venezuela and Bolivia. If precipitation decreases in South America, other countries that depend on its economic activities could be affected. A reduction in rain can lead to drought, which in turn can cause livestock production to drop drastically.

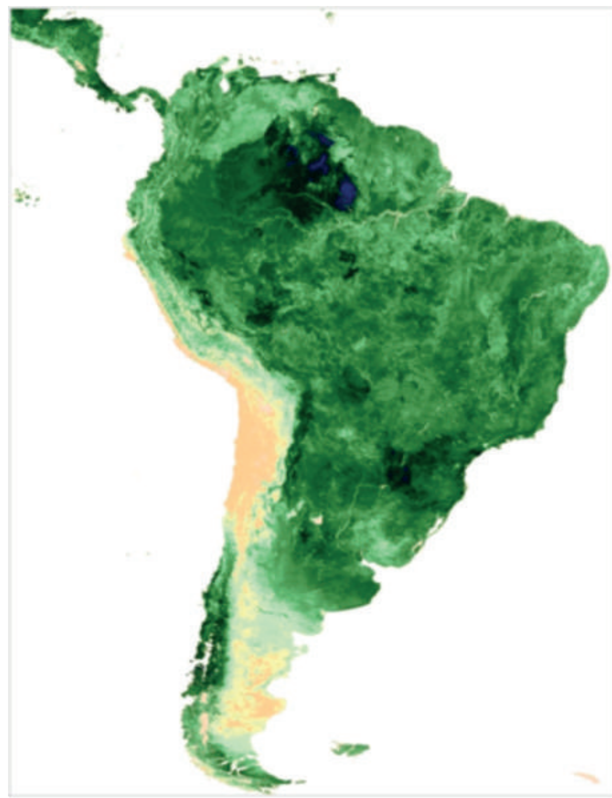


Figure 8. SPOT Normalised Difference Vegetation Index
Source: ESA (n.d.)

Rangelands

As Figure 9 illustrates, the most extensive ecosystems are grasslands, shrublands and deserts, found on the Caribbean coast of Venezuela, north-eastern Brazil, and inland areas between Brazil and Bolivia. Mid-latitude grasslands occupy areas in southern Brazil, Uruguay and central and eastern Argentina. Tropical grasslands and savannahs are present in the Guianas, Venezuela, Colombia, Brazil, Paraguay and

Argentina. Arid shrublands occupy the west of Argentina and Patagonia, and hyper-arid areas exist along the west coast of Peru and northern Chile, as well as in southern Bolivia and north-western Argentina (ESA, n.d.).

Rangelands are made up of grasslands, shrublands, savannahs and hot and cold deserts. They cover 33% of the South American continent. Rangeland productivity and species composition are both related to a highly variable amount of seasonal distribution of precipitation. Rangelands sustain pastoralist activities, subsistence farming and commercial ranching. Any alteration of the standing capacity of grasslands will have a huge economic impact, given the scale of livestock production in tropical and temperate grasslands.

Figure 9. World Heritage Sites and IUCN/SSC First-level Habitat Types in South America.
Source: Magin and Chape (2004)

Páramos -tropical Andean ecosystems- are usually located above the Andean forests, at elevations over 3,000 m.a.s.l., they are predominantly found in the Northern Andes, ranging from northern Peru to Ecuador, Colombia and Venezuela.

Climate change is affecting high mountain ecosystems and páramos, expressed in, and leading to: a) a reduction in water retaining capacity and soil carbon stock, as a result of increased temperature and decreased rainfall; b) losses in biodiversity and ecosystems services such as the reduction of the national hydropower potential; c) a change in rainfall frequency and intensity; d) increased recurrence of extreme weather events (hail, frost, torrential downpours, waves, and variation in rainfall/drought periods); e) a change in water quantity and quality; f) a decrease in crop yield by changes in cropping periods, and the disappearance of some crops and occurrence of diseases including pests; g) changes in forest structure, composition and geographic ranges; and h), changes in cultural patterns, among others (Andrade *et al*., 2010).

Deserts

Extremely arid deserts are those that get less than 100 mm in annual precipitation. These deserts make up a large proportion of the Peruvian, Atacama, and Patagonian regions. They are home to a significant amount of species and have a high degree of endemism.

Mountain ecosystems and cryosphere

Mountain chains in South America influence climate, hydrological cycles and biodiversity. Mountainous areas are exposed to extreme weather and climate phenomena, such as high or low temperatures and precipitations. The cryosphere region is composed of the Andes glaciers, Patagonia's ice fields and the Darwin ice field in Tierra del Fuego. Seasonal snowfall on the high Andes is critical for the subsistence of communities in central Chile and large piedmont communities in Argentina, where water supply depends almost entirely on snowmelt.

Mountain ranges and plateaus conserve the biological diversity and unique ecological state of the river. There are glaciers in the high Andes (Venezuela and Peru) and three major ice sheets in the Patagonian Andes. Climate change and the *El Niño* Southern Oscillation (ENSO) phenomenon in particular can modify the rate of snowfall and runoff in areas of piedmont. Approximately 35% of the world's continental water is found in the region (ESA, n.d.).

The rural poor are particularly dependent on forest resources and depend substantially on forest ecosystems for their subsistence and survival. In addition to providing essential ecosystem services such as habitat for biodiversity and provisioning clean water supplies, forests in South America support the livelihoods of a large number of Indigenous Peoples and forest-dependent communities, who are especially dependent on forest resources and the health of forest ecosystems (MEA, 2005). However, rapid population growth, displacement and rural economic collapse have triggered one of the fastest urbanisation rates in the region.

Socio-economic context

Population

As of 2014, the total population in South America was estimated at 414 million inhabitants, representing approximately 18 percent of the world's population. The most populous countries in the region were Brazil (50%), Colombia (12%), Argentina (10%), Peru (8%) and Venezuela (7%); whilst the countries with the greatest rural populations are Guyana (72%), Paraguay (41%), Ecuador (37%), and Bolivia (32%); the region's rural population as a whole accounted for 17% of total population.

that integrate biodiversity conservation, ecosystem management, DRR and climate change adaptation (CCA).

Urban population, on the other hand, accounted for 80% of the region's total population; with almost all countries in the region experiencing a high degree of migration from rural to urban areas. The link between urbanisation and natural disasters is currently part of an international debate, which casts light on the complex effects that urbanisation has on territories. According to the Economic Commission

Table 5. Population characteristics of countries in South America, 2014

Countries	Total population	Share of total population	Population Density	Rural population	Share of rural population	Urban population	Share of urban population	Human Development Index 2013	Gender Inequality Index 2013
Unit	Inhabitants	%	inhab/km^2	Inhabitants	%	Inhabitants	%	(Min 0, Max 1)	(0=best, 1=worst)
Argentina	42,980,026	10.4	15.71	3,608,603	8.4	39,371,423	91.6	0.808	0.381
Bolivia	10,561,887	2.6	9.75	3,368,503	31.9	7,193,384	68.1	0.667	0.472
Brazil	206,077,898	49.8	24.66	30,019,367	14.6	176,058,531	85.4	0.744	0.441
Chile	17,762,647	4.3	23.89	1,890,656	10.6	15,871,991	89.4	0.822	0.355
Colombia	47,791,393	11.5	43.07	11,392,990	23.8	36,398,403	76.2	0.711	0.460
Ecuador	15,902,916	3.8	64.03	5,802,020	36.5	10,100,896	63.5	0.711	0.429
Guyana	763,893	0.2	3.88	546,497	71.5	217,396	28.5	0.638	0.524
Paraguay	6,552,518	1.6	16.49	2,659,274	40.6	3,893,244	59.4	0.676	0.457
Peru	30,973,148	7.5	24.20	6,725,819	21.7	24,247,329	78.3	0.737	0.387
Suriname	538,248	0.1	3.45	182,547	33.9	355,701	66.1	0.705	0.463
Uruguay	3,419,516	0.8	19.54	165,778	4.8	3,253,738	95.2	0.790	0.364
Venezuela	30,693,827	7.4	34.80	3,394,430	11.1	27,299,397	88.9	0.764	0.464
South America	414,017,917			69,756,484	16.8	344,261,433	83.2		

Source: Own elaboration based on World Development Indicators (2015) for Latin America and the Caribbean (ECLAC), "urbanisation is one of the forces intensifying and expanding the human factor in today's natural disasters. Essentially, urbanisation necessarily creates an artificial environment and encourages production and consumption patterns that put pressures on the ecosystem, increasing the likelihood of local and global ecosystem imbalances that lead to natural disasters" (ECLAC, 2016).

South America has the highest urbanisation rate in the world. Urban settlements have established themselves from sea level to mountain ranges exceeding 3,000 m.a.s.l. These locations have a wide variety of geographic and topographic conditions, which often make them particularly vulnerable to the impacts of natural hazards. For instance, in the Andean and highland regions, people may populate precarious zones, living on or near potentially unstable slopes; while at sea level, people inhabit coastal areas, estuaries, and valley systems near rivers and streams. In this sense, the occurrence of flooding and landslides has adverse effects on the welfare and health conditions of more vulnerable populations.

Economy

South America is currently experiencing an economic slowdown due to the region's vulnerability to a lower external demand and a fall in commodity prices. After an average annual growth of 4.6% from 2004 to 2013, the region's gross domestic product (GDP) expanded only 2.6% in 2014, reaching US$ 4 trillion in the same year (Table 6).

Table 6. Gross Domestic Product by country, 2014

Countries	Total GDP	Share of total GDP	Annual growth rate 2010–2014	GDP per capita	Value added by agriculture [1]
Unit	million US$	%	%	US$/inhab	% of GDP
Argentina	543,061	13.0	4.1	12,735	6.7
Bolivia	33,237	0.8	13.8	2,943	12.9
Brazil	2,346,583	56.4	1.5	11,573	5.3
Chile	258,017	6.2	4.4	14,480	3.2
Colombia	377,867	9.1	7.1	7,928	6.3
Ecuador	100,543	2.4	9.6	6,273	9.1
Guyana	3,059	0.1	7.8	3,826	18.7
Paraguay	30,220	0.7	10.0	4,379	18.1
Peru	202,642	4.9	8.1	6,449	7.4
Suriname	5,210	0.1	4.5	9,427	7.1
Uruguay	57,471	1.4	9.3	16,882	9.3
Venezuela	206,252	5.0	(6.7)	6,772	5.5
South America	4,164,162		2.6		

Source: Own elaboration based on World Economic Outlook, IMF (2015); and 1World Development Indicators (2015)

As Table 7 indicates, in 2013 the economically active population in South America accounted for 51% of the total population. Agriculture remains the backbone of the region's economic activity, with over 25 million people depending on agriculture for their livelihoods. Important agricultural activities include coffee, soybeans, wheat, rice, corn, sugarcane, cocoa, citrus, beef, bananas and shrimp.

Table 7. Total economically active population and share in agriculture, 2013

Countries	Total economically active population	Share of total population	Economically active population in agriculture	Share of economic active population
Unit	inhabitants	%	inhabitants	%
Argentina	19,699,000	48.0	1,378,000	7
Bolivia	5,337,000	50.0	2,150,000	40
Brazil	104,439,000	52.0	10,211,000	10
Chile	7,606,000	43.0	956,000	13
Colombia	25,545,000	53.0	3,467,000	14
Ecuador	7,427,000	7.0	1,268,000	17
Guyana	373,000	47.0	51,000	14
Paraguay	3,624,000	53.0	861,000	24
Peru	16,428,000	54.0	3,780,000	23
Suriname	203,000	38.0	33,000	16
Uruguay	1,689,000	50.0	184,000	11
Venezuela	14,739,000	48.0	687,000	5
South America	207,109,000	51	25,026,000	12

Source: Own elaboration based on population characteristics, FAO (2015)

With over 412 million ha, South America has approximately 23% of the world's potential cultivable land, but the total cultivated lands in 2012 reached almost 148 million ha, representing 36% of cultivable area in the region (FAO, 2015b; Table 8). The quality of land and climate is important in determining the agricultural potential of land, and the region has historically been characterised by its ability to incorporate more land into agricultural production. But whilst there is still potential for further expansion in the region, the expansion of the agricultural frontier –characterised by the conversion of native habitats to agriculture– has critical environmental impacts, including deforestation of vast areas high in biodiversity, especially in the Amazon region. Additionally, the use of agrochemicals and soil erosion caused by unsustainable farming practices has led to major negative impacts on terrestrial, aquatic and marine biodiversity.

Table 8. Cultivated land and cultivable area in South American countries, 2012

Countries	Land area			Cultivable area		Cultivated area			
Unit	1,000 ha	in % of region	ha/ inhab	1,000 ha	% of country area	1,000 ha	% of country area	% of cultivable area	ha/ inhab
Argentina	278,040	15.7	6.7	174,000	62.6	40,291	14.5	23.2	0.98
Bolivia	109,858	6.2	10.3	25,908	23.6	4,515	4.1	17.4	0.43
Brazil	851,577	48.1	4.3	138,000	16.2	79,605	9.3	57.7	0.4
Chile	75,610	4.3	4.3	5,100	6.7	1,794	2.4	35.2	0.1
Colombia	114,175	6.4	2.4	10,398	9.1	3,453	3.0	33.2	0.07
Ecuador	5,637	1.4	1.6	10,523	41.0	2,531	9.9	24.1	0.16
Guyana	21,497	1.2	26.9	496	2.3	448	2.1	90.3	0.56
Paraguay	40,675	2.3	6.0	23,817	58.6	4,500	11.1	18.9	0.67
Peru	28,522	7.3	4.2	7,609	5.9	5,529	4.3	72.7	0.18
Suriname	16,382	0.9	30.4	1,500	9.2	66	0.4	4.4	0.12
Uruguay	17,622	1.0	5.2	4,000	22.7	1,795	10.2	44.9	0.53
Venezuela	91,205	5.2	3.0	10,986	12.0	3,400	3.7	30.9	0.11
South America	1,770,800	100	4	412,337	23.3	147,927	8.4	35.9	0.37

Source: Own elaboration based on land-use characteristics, FAO (2015b)

Socioeconomic and educational conditions vary widely among Latin American countries. Poverty is widespread and may be aggravated by global warming if the impacts contribute to declines in the sustainability of Latin America's ecosystems, particularly in areas with marginal environmental and socioeconomic conditions (IPCC, 2014b).

Natural hazards in South America

Countries in South America experience a range of natural hazards. These natural hazards may lead to disasters, which can be understood as a serious disruption of the functioning of a community or society that involves widespread human, material, economic or environmental losses and impacts, which exceeds the ability of the affected community or society to cope using its own resources.

To better understand the risk of disasters in the region, it is necessary to first identify the predominant natural hazards ––understood as geophysical and hydro-meteorological events–– that have the potential to cause harm or loss; by means of an introduction, a brief description of each is provided in Table 9.

Data on natural hazards in South America was sourced from the EM-DAT database[9] maintained by the Centre for Research on the Epidemiology of Disasters (CRED), as it is considered the most comprehensive, publicly available global database on natural hazards and their impacts. This served as an important resource, especially in light of the time constraints for carrying out the assessment.

Owing to its geological, climatic, hydrological and geomorphological characteristics, South America is exposed to diverse natural hazards that have considerable destructive potential. An analysis was conducted through a revision of data reported to the EM-DAT for the past 15 years. The region reported 465 natural disasters during the period 2000–2015, which accounted for 22% of global occurrence. According to statistical information, floods accounted for 50% of the total occurrence of natural hazards in the region; followed by storms (9%), landslides (8%) and extreme temperatures (8%).

[9] The EM-DAT database is compiled from multiple sources, and includes disasters from 1900 to the present, with estimates of numbers of people killed and affected as well as estimates of economic losses, derived from documented sources. The database is not exhaustive as it does not include geophysical or hydro-meteorological events not reported as causing significant losses; either because the events occurred in areas that were thinly populated at the time, or because the losses were not significant..

Table 9. Principal natural hazards in South America

Natural hazard	Significance
Avalanche	An avalanche is a mass of snow and ice falling suddenly down a mountain slope, often taking earth, rocks and rubble with it. Avalanches can be highly destructive, moving at speeds in excess of 150 km/h.
Desertification	Land degradation in arid, semi -arid and dry sub-humid regions resulting from various factors, including climatic variations and human activities.
Drought	The primary cause of any drought is deficiency of rainfall. Drought is different from other hazards in that it develops slowly, sometimes over years, and its onset can be masked by a number of factors. Drought can be devastating: water supplies dry up, crops fail to grow, animals die and malnutrition and ill health become widespread.
Earthquake	Earthquakes mostly occur at fault zones, where tectonic plates collide or slide against each other. These impacts are usually gradual and unnoticeable on the surface; however, immense stress can build up between plates and be released quickly, sending massive vibration, called seismic waves, often hundreds of miles through the rock and up to the surface. Scientist s assign a magnitude rating to earthquakes based on the strength and duration of these seismic waves.

...

Temperature extreme	Heat waves are most deadly in mid -latitude regions, where they concentrate extremes of temperature and humidity over a period of a few days in the warmer months. The oppressive air mass in an urban environment can result in many deaths, especially among the very young, the elderly and the infirm. Extremely cold spells cause hypothermia and aggravate circulatory and respiratory diseases.
Tsunami	A series of waves in a water body caused by the displacement of a large volume of water, generally in an ocean or a large lake. Earthquakes, volcanic eruptions and other underwater explosions (including detonations of underwater nuclear devices), landslides, glacier calvings, meteorite impacts and other disturbances above or below water all have the potential to generate a tsunami.
Volcano	A type of volcanic event near an opening/vent in the Earth's surface including volcanic eruptions of lava, ash, hot vapour, gas and pyroclastic material.
Wildfire	Massive and devastating fires can be triggered during and after periods of drought, by lightning or by human action. As well as destroying forests, grasslands and crops, they kill livestock and wild animals, damage or destroy settlements and put the lives of inhabitants at risk.

Source: WMO (n.d.), IPCC (2014a), EM-DAT (2016). UNCCD (2013)

The following provides an overview of the most significant disaster by type, their occurrence and impacts both in terms of populations affected and economic damages incurred. It is important to mention that data availability depends on the countries reporting information; which is particularly important in terms of economic losses, since damages are not always specified in the EM-DAT database.

Floods

As previously stated, floods are the most prominent natural disaster reported in South America during the period 2000–2015. Brazil represented 24.35% of the total occurrence of these events, yet all twelve countries were affected almost every year; adding more than half of the total fatalities and more than a third of the total population affected by natural disasters in the region. Colombia, Brazil, Bolivia and Peru accounted for 86% of mortalities and 85% of people affected by floods (Figure 10). In terms of economic losses, a total damage of US$ 15 billion was registered during the period 2000–2015.

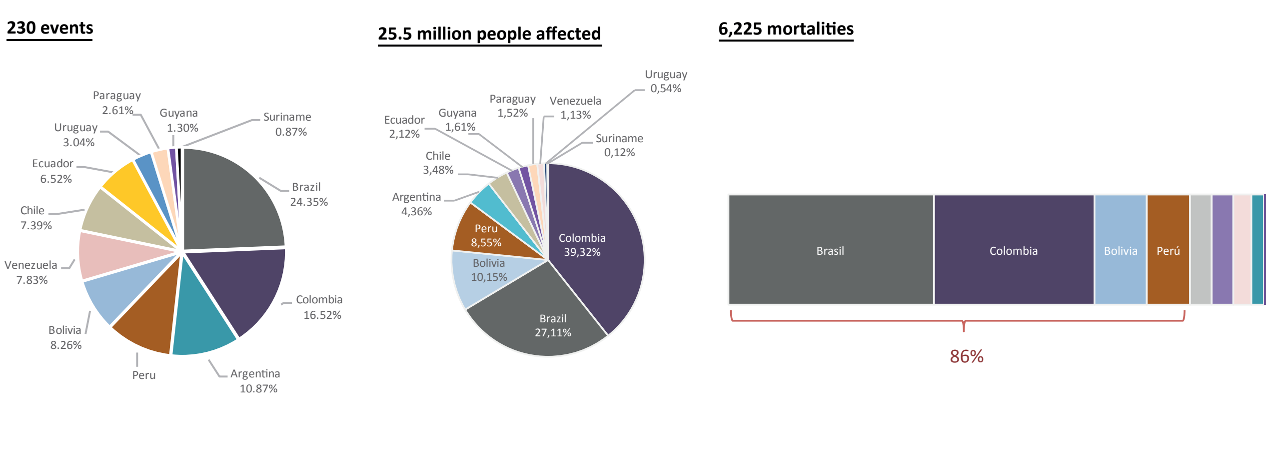


Figure 10. Flood incidence in South America, 2000–2015 | *Source: Own elaboration based on EM-DAT (2016)*

Droughts

Droughts accounted for only 6% of the occurrence of natural hazards in South America, but they were responsible for 48% of the total population affected by natural disasters. Droughts were registered in almost all of the twelve countries, yet its occurrence was mostly reported on a regular basis in Brazil, Bolivia and Paraguay. Brazil reported 33 million people affected during the period 2000–2015, accounting for 93% of the total population affected by droughts in the region (Figure 11). In terms of damages, economic losses reached US$ 8 billion, reported also mainly by Brazil.

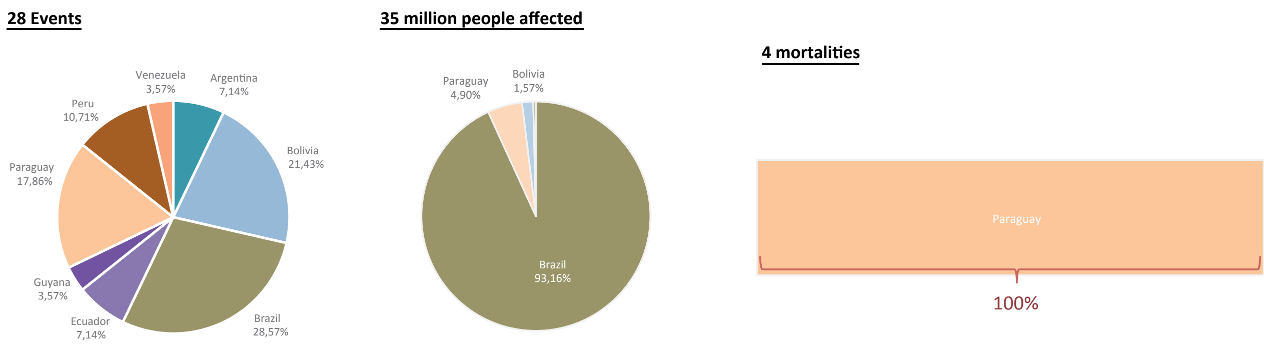


Figure 11. Drought incidence in South America, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

Storms

Storms were the second most important natural hazard reported in the region in terms of occurrence, yet they only represented 3% of mortalities and less than 1% of the population affected by natural disasters in the region. A third of these events occurred exclusively in Argentina, where 30% of fatalities were also reported. Storms affected almost half a million people in the region during the period 2000–2015 (Figure 12); most of them were reported in Brazil (37%), Paraguay (32%) and Peru (19%). In terms of economic losses, information is available for Argentina, Brazil, Paraguay and Uruguay; these countries together registered total estimated damages of US$ 517 million during the period 2000–2015.

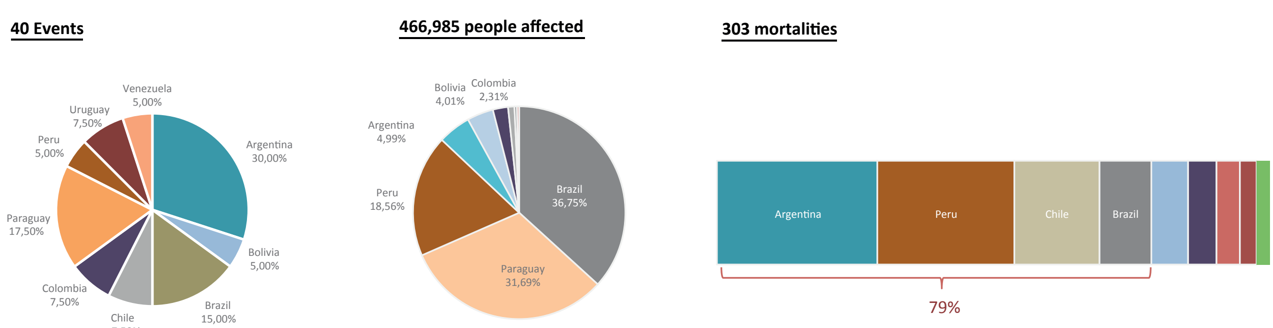


Figure 12. Storm incidence in South America, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

Landslides

Landslides represent the natural disaster with the third highest reported incidence in the region, and the fourth cause of total mortalities. Whilst Colombia and Peru accounted for 55% of landslide occurrence and were responsible for 62% of deaths, most of the people affected were registered in Brazil and Argentina (88%) (Figure 13). In terms of economic losses, only Argentina, Bolivia and Brazil registered information related to these events; with a total estimated damage of US$ 446 million during the period 2000–2015.

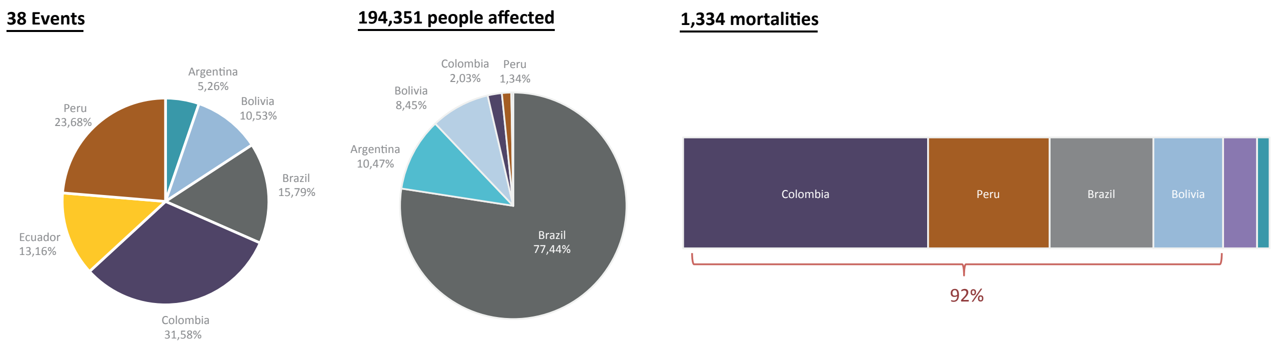


Figure 13. Landslide incidence in South America, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

Extreme temperatures

Extreme temperatures occurred as much as landslides during the period 2000–2015, yet these events were the second cause of deaths attributed to natural disasters in the region. Whilst most of the countries registered less than a hundred deaths associated with extreme temperatures, Peru reported almost 2,000 mortalities and 5 million people affected (Figure 14). Only Chile reported information in terms of economic losses, with an estimated US$ 1 billion in damages related to extreme temperatures.

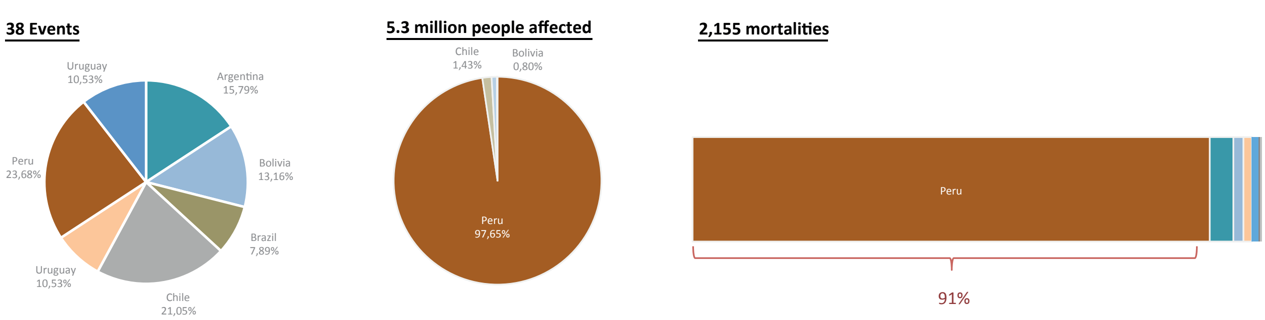


Figure 14. Extreme temperature incidence in South America, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

Epidemics

Epidemics have been reported by most of the countries over the last 15 years. Although the majority of the events were registered in Paraguay, most of the people affected were located in Brazil, where 1.5 million of the population suffered from epidemics and 80% of related deaths were documented (Figure 15). There is no available information on economic losses.

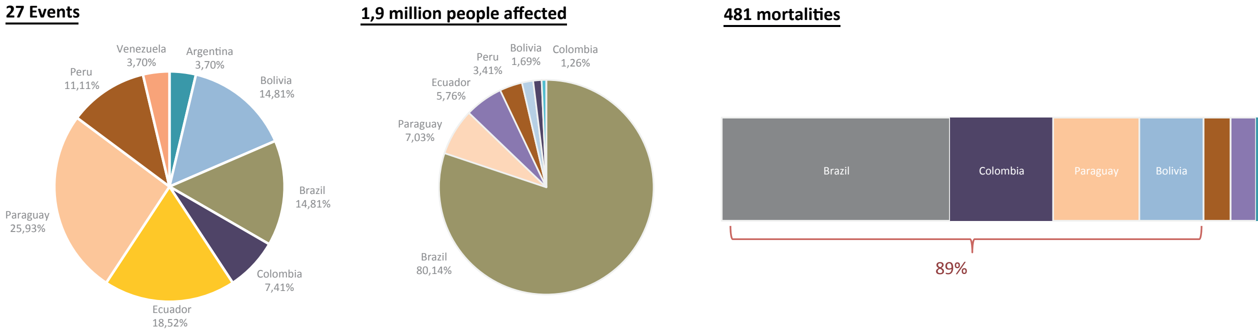


Figure 15. Epidemic incidence in South America, 2000–2015. *Source: Own elaboration based on EM-DAT (2016)*

Earthquakes

Earthquakes were responsible for 1,368 mortalities and 4.3 million people affected during the period 2000–2015. Peru reported over a third of these events, but Chile registered the population most affected in the region, impacting 3.2 million people. Together, these two countries represented 98.6% of deaths related to earthquakes (Figure 16). Chile reported US$ 30.3 billion in economic losses, 99% of which was specifically related to the year 2010.

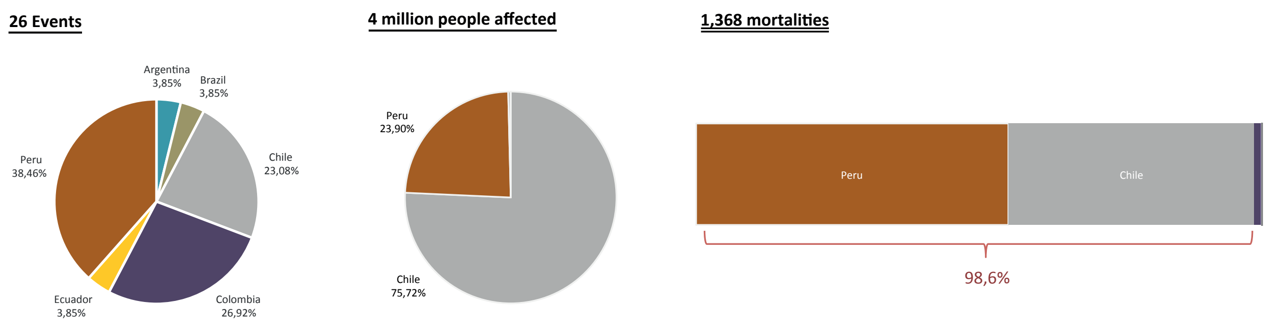


Figure 16. Earthquake incidence in South America, 2000–2015. *Source: Own elaboration based on EM-DAT (2016)*

Volcanic activity

Volcanic activity accounted for less than 5% of total natural disasters recorded in the region during the period 2000–2015. Most of the events occurred in Colombia and Ecuador, affecting over half a million people, especially in Ecuador. Together, both countries reported a total of 21 fatalities, 76% of them recorded in Colombia (Figure 17). In terms of economic losses, Colombia did not register information, thus the total estimated results from Ecuador and Argentina reached US$ 264 million.

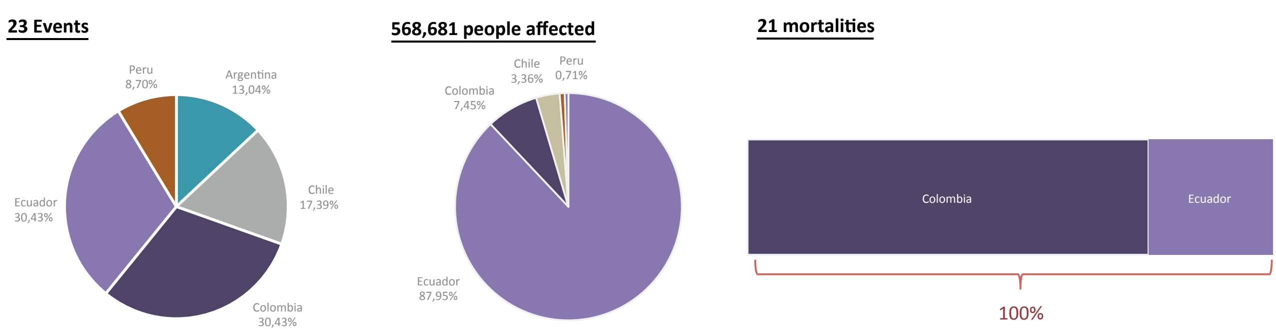


Figure 17. Volcanic activity incidence in South America, 2000–2015. *Source: Own elaboration based on EM-DAT (2016)*

Wildfires

From the nine natural disasters recorded in the region, wildfires took the last place in terms of occurrence and population affected. Whilst most wildfires occurred in Chile, affecting 12,767 people, Paraguay recorded 125,000 people affected from one single event (Figure 18). In terms of economic losses, both countries reported a total of US$ 544 million.

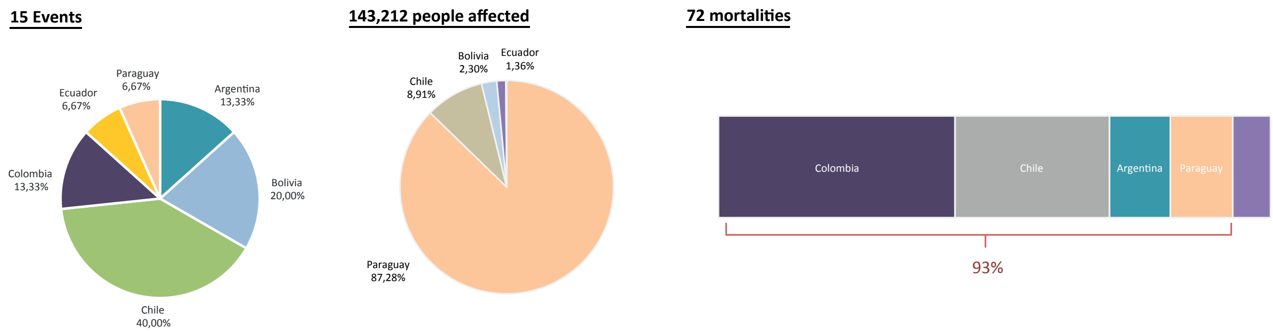


Figure 18. Wildfire incidence in South America, 2000–2015. *Source: Own elaboration based on EM-DAT (2016)*

In summary, in terms of occurrence, floods affected all countries in the region during the period 2000–2015. Countries with the highest reported incidence of landslides are Colombia (32%), Peru (24%), Brazil (16%) and Ecuador (13%). Earthquakes and volcanic activity are prevalent along the Pacific coast; with Peru, Chile, Colombia and Ecuador together accounting for 92% of earthquakes and 87% of volcanic activity. More than half of the countries suffered from extreme temperatures, with Chile and Peru representing 45% of total occurrence. Half of droughts happened in Brazil and Bolivia, and most storms and wildfires were reported in Argentina (30%) and Chile (40%), respectively. In terms of epidemics, Paraguay (26%), Ecuador (19%), Brazil (15%) and Bolivia (15%) were the most affected.

In this sense, natural disasters are frequent in the region. The scale of human and economic damage caused by these events depends on the level of exposure to hazards and the inherent vulnerabilities for each country. Statistical evidence indicates that disasters are increasing in number, cost and impact. In 2000–2015, natural disasters in South America caused a reported **US$ 57 billion** in total economic damages, affecting almost **74 million people** (equivalent to the population of Turkey), claiming an **estimated 11,963 lives** – equivalent to two deaths every day (Figure 19). Only seasonal floods and droughts (56% of disasters) – which affect the entire region, particularly the Amazon, Andean Valleys, La Plata Basin and Northeast Brazil – are responsible for 52% of mortalities, 83% of the affected population and account for 41% of the economic losses.

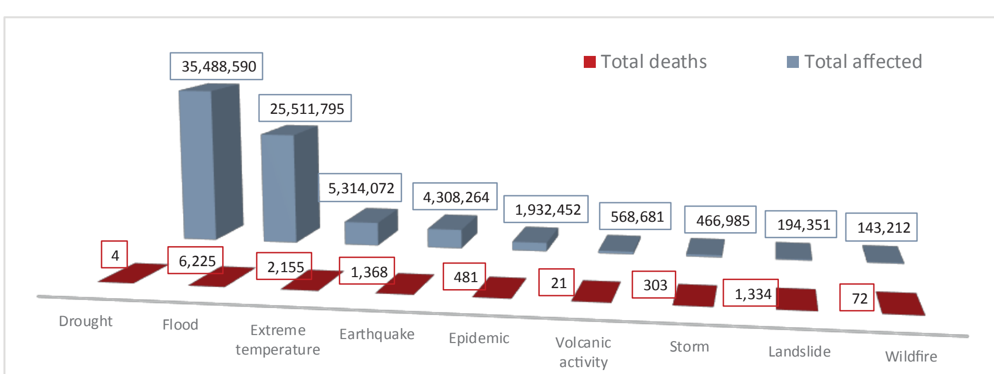


Figure 19. Total deaths and people affected by disaster type in South America, 2000–2015. *Source: Own elaboration based on EM-DAT (2016)*

The brief analysis of the incidence of natural hazards in the region has enabled the identification of the principal countries affected. According to statistical information, 70% of total reported disasters in South America happened in six countries: Argentina, Bolivia, Chile, Colombia, Ecuador and Peru. Together these countries account for 60% of floods, 84% of landslides, 74% of extreme temperatures, 55% of storms, 47% of drought, 93% of wildfire, 100% of volcanic activity, 56% of epidemics and 96% of earthquakes, as shown in Figure 20.

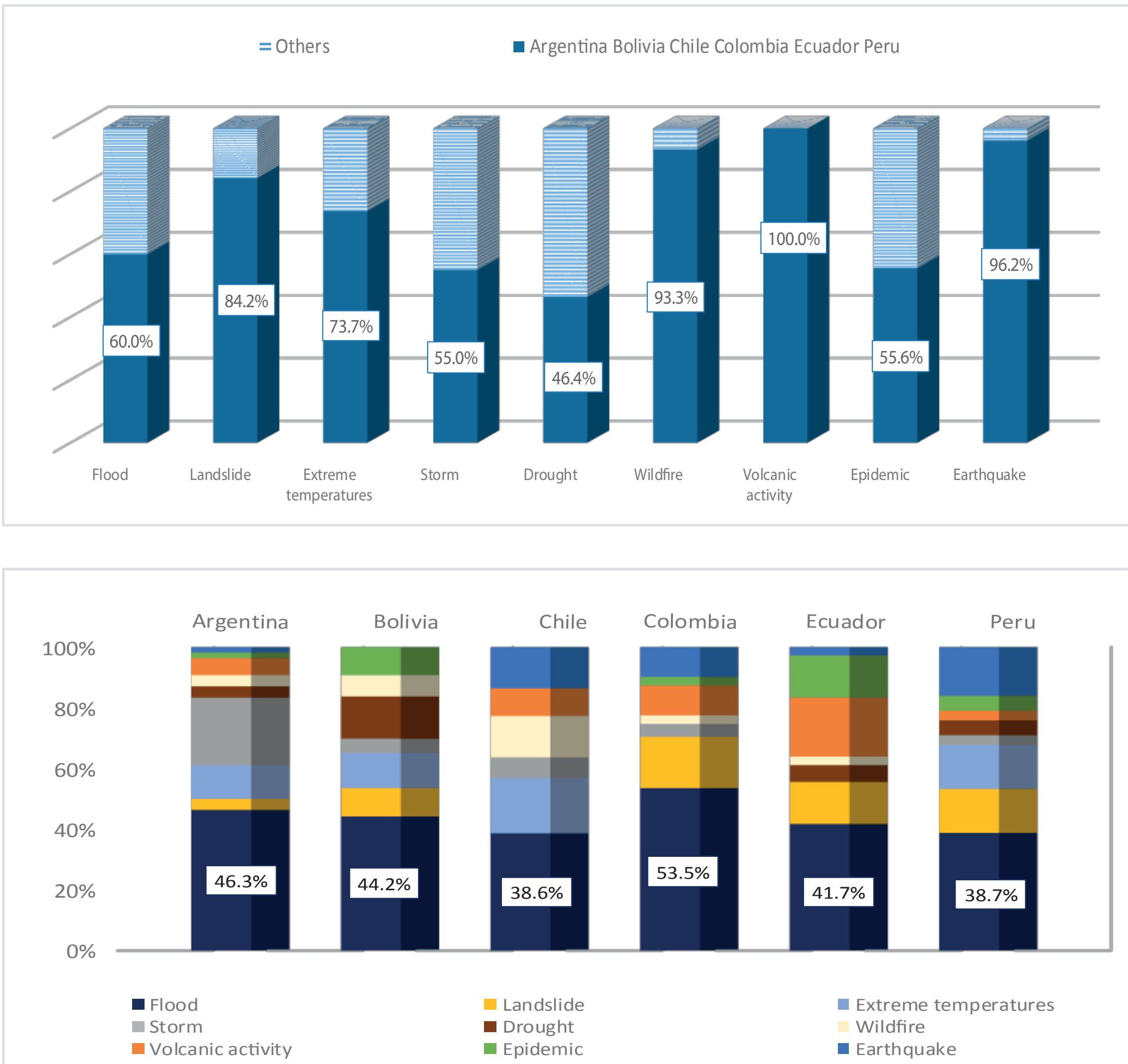


Figure 20. Occurrence by disaster type in main countries, 2000–2015. *Source: Own elaboration based on EM-DAT (2016)*

Hence, for the purpose of this regional assessment, the analysis will focus on these six countries. The next chapter presents a more in-depth analysis for the six focus countries of natural hazards and disasters, along with Eco-DRR related policies, and explores some of the ways biodiversity and ecosystems influence DRR strategies in each country.

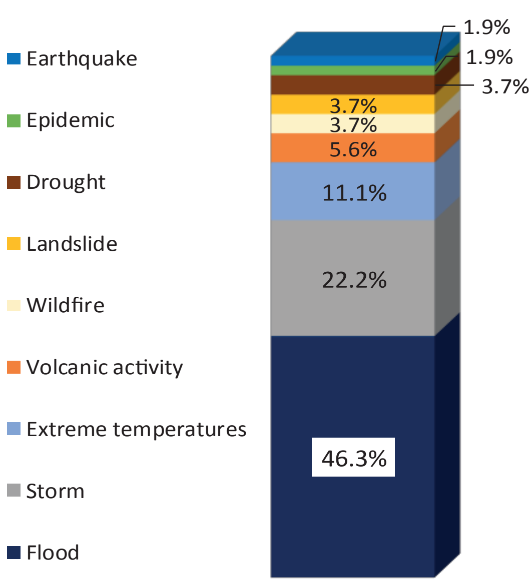
3.1 Case study: Argentina

Key indicators	Unit	in % of region
Land area (km^2)	2,780,400	15.7
Forest area (km^2)[1]	289,204	3.4
Total population	42,980,026	10.4
Rural	3,608,603	8.4
Urban	9,371,423	91.6
GDP(million US$)	543,061	13.0
Period 2000–2015	**Total**	**in % of region**
Registered hazards	54	11.6
Deaths	351	2.9
Affected people	1,175,519	1.6
Economic losses (´000 US$)	3,744,210	6.5

Source: own elaboration based on WDI (key indicators) and EM-DAT (natural hazards), 2016
Note: 1 Last data available from 2012

Natural hazards

Argentina reported 54 hazardous events during the period 2000–2015. As seen in Figure 21, floods, storms and extreme temperatures accounted for 80% of the total occurrence of natural hazards, resulting in 309 deaths and 1.1 million people affected. These three events together were responsible for 88% of mortalities and 97% of the population affected by the total events registered in the country.



Disaster type	Total affected	Total deaths
Flood	1,111,278	136
Storm	23,298	88
Landslide	20,350	28
Epidemic	13,366	6
Extreme temperatures	3,500	85
Volcanic activity	3,000	-
Earthquake	727	
Wildfire	-	8
Drought	-	-
Total	1,175,519	351

Figure 21. Most common hazards in Argentina, 2000–2015 | *Source: Own elaboration based on EM-DAT (2016)*

Floods accounted for 46% of the total occurrence of natural hazards in Argentina, accounting for 95% of the population affected by disasters in the country. With over a million people affected and more than a third of the total mortalities associated with natural hazards, floods became the most significant disaster reported by Argentina during the period 2000–2015, resulting in 1.1 million people affected, 136 deaths and US$ 3.4 billion in economic losses.

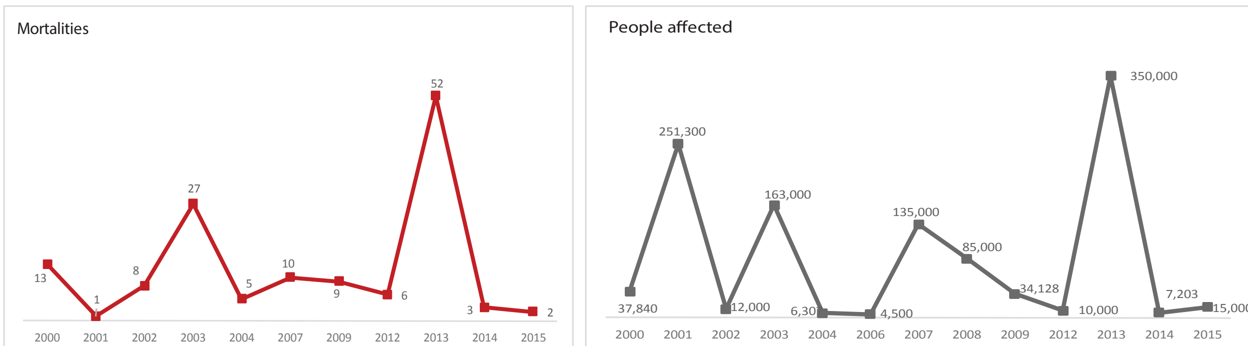


Figure 22. Total deaths and people affected by floods in Argentina, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

In terms of damages, data is not available for the entire 16-year period; however, economic losses were reported for those years with the largest affected population. In 2001, three floods were registered, which accounted for 251,300 people affected and US$ 750 million in damages. In 2003, two floods accounted for 163,000 affected and US$ 1 billion in damages. And in 2013, one flood affected 350,000 people, resulting in US$ 1.3 billion damages (Figure 22).

Following floods, the most important natural hazard reported by Argentina were storms and extreme temperatures. These events affected only 2% of the population, yet they were responsible for 49% of total mortalities associated with disasters in the country. Storms caused 88 deaths, followed closely by 85 casualties recorded for extreme temperatures (Figure 23).

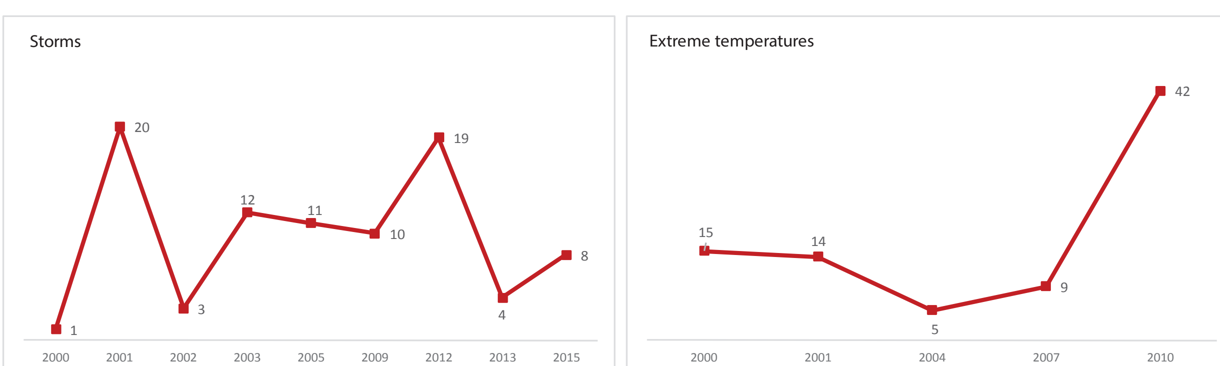


Figure 23. Total deaths by storms and extreme temperatures in Argentina, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

Regarding the occurrence of extreme events and disasters in relation to the rest of the region, Argentina alone represented a third of total reported storms in South America. As seen in Figure 24, it is also one of the countries with the highest occurrence of extreme temperatures (16%), wildfires (13%), volcanic activity (13%) and floods (11%) in the region.

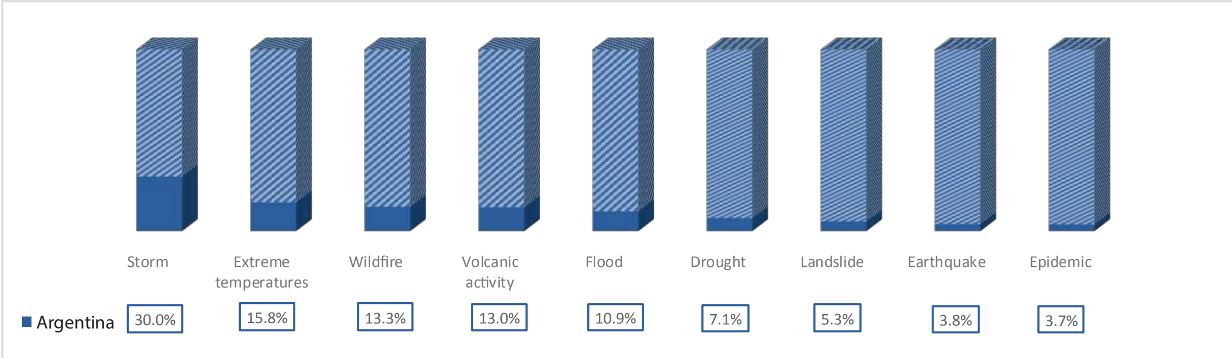


Figure 24. Argentina's Proportion of main hazards in the region, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

Argentina's climate is mostly temperate, but ranges from subtropical in the north to arid and cold in the far south. With a high level of inter-annual climate variability due to the *El Niño* Southern Oscillation (ENSO), these conditions also bring above average rainfall that can lead to floods, whereas *La Niña* brings drier conditions (IISD, 2011).

Policies and strategies related to Eco-DRR

This section provides an overview of the policy context in Argentina, to determine the integration of nature-based solutions into DRR strategies, as a way to reduce risks from disasters, adapt to climate change, and secure main ecosystem services such as water, food and energy supplies.

Biodiversity status, trends and threats

According to the country profile on the CBD, the Republic of Argentina is classified as one of the world's megadiverse countries, with 15 continental zones, 3 oceanic zones and the Antarctic region all represented in its territory. This diversity of ecosystems has led to considerable species diversity: 9,000 vascular plant species (30% endemics) and 2,380 vertebrate species, of which there are 38 endemic species of mammals and 19 endemic species of birds. From this total, 529 species of vertebrates and at least 240 plants are threatened or face extinction. The **main threats** to biodiversity are **conversion of natural land for agriculture and deforestation**; however, **alien invasive species, industrialisation and urbanisation** are also significant contributors to biodiversity loss[10]. Forests cover approximately 34% of the national territory in Argentina (FAO, 2015b).

Fifth National Report

Desertification poses a significant risk in the country; an estimated three-quarters of the territory is classified as **arid or semi-arid areas**. These naturally vulnerable regions have historically experienced degradation caused by land appropriation and unsustainable land use practices. Argentina has strengthened provincial and local level implementation of public policy to promote efficient and sustainable land use, and promotion of best practice for sustainable land use management; amongst which, are the following programme and project:

- National Programme of Action to Combat Desertification (*Programa de Acción Nacional de Lucha contra la Desertificación – PAN*).
- Increased Climate Resilience and Improved Sustainable Land-use Management in the south-west of Buenos Aires province (*Proyecto "Incremento de la Resiliencia Climática y Mejora de la Gestión Sustentable del Suelo en el Sudoeste de la Provincia de Buenos Aires-Argentina*).

Additionally, as part of Initiative 20x20, Argentina has committed a total of 1 million hectares for restoration by 2020.

[10] CBD (n.d.). Argentina – Country Profile (https://www.cbd.int/countries/default.shtml?country=ar)

National Biodiversity Strategy and Action Plan (NBSAP)
The general goals of Argentina's NBSAP are to: guarantee the conservation and sustainable use of biological resources; reduce adverse effects of production activities on biological diversity; and the equitable sharing of benefits derived from the appropriate use of genetic resources.

The NBSAP sets out, according to the themes of the 2010 Biodiversity Target, different objectives and actions for each thematic area. These themes include: **sustainable use** of biodiversity, **restoration of degraded lands**, bio-regional planning and use of land, protected areas and education, communication and capacity-building.

The actions identified in the NBSAP should serve to strengthen: the integration of biodiversity-related issues in the sectoral plans and programmes that lead to national development and increase in life quality; understanding of functions of genes, species and ecosystems; access to information related to biodiversity by different sectors of society; the process of moving towards models of use and consumption that are compatible with maintaining essential ecological processes, while trying to avoid a reduction in the natural capital of Argentina; the fair and equitable sharing of the benefits derived from the use of genetic resources; and the conservation of the cultural heritage of Argentina.

National Adaptation Plan
Argentina has not submitted its National Adaptation Programme of Action to the UNFCCC, but it has published two **National Communications to the UNFCCC** – the first in 1997 and the second in 2007. Between these reports, it created a **National Program on Climate Change Impacts** in 2006 with a view to improve understanding of vulnerability and impacts and to help design adaptation measures. An additional programme addresses the same questions in the Antarctic region and islands (República Argentina, 2007).

Although Argentina has a Local Development Plan (*Plan Estratégico Territorial – PET*), it doesn't have a **National Development Plan** *per se*, its development is instead guided by a set of strategic national policies. Climate change, but not adaptation in particular, is mentioned in these policies in relation to its environment. A **National Climate Change Strategy** has been elaborated through a participatory process that addresses both climate change adaptation and mitigation.

The Secretariat for Environment and Sustainable Development (SAyDS) is the UNFCCC focal point. It operates on climate change issues through its Climate Change Directorate (DCC). Furthermore, there is a **National Consulting Commission on Climate Change (CNACC)** that brings together representatives of various ministries at the national level, regional governments, universities and private sector (IISD, 2011).

National Disaster Management Plans
The National Programme for Disaster Risk Prevention and Reduction, developed since 2006, has as its objective to promote the inclusion of DRR in land use and development policy at all levels in the State. This is achieved through awareness raising and the strengthening of capacities of key stakeholders, and includes risk analysis in the planning and evaluation of public investment projects.

In 2010, "Disaster Risk in Development Planning" was published as a result of the National Programme; this was followed by a Joint Declaration between the Department of Climate Change and the National Direction of Civil Protection, which outlined common risk reduction strategies, especially related to climate change risk, at different scales. This collaboration resulted in the elaboration of the "Manual of Vulnerability to Climate Change for Disaster Management and Local Planning".

In 2012, Argentina developed its Disaster Risk Country Document under the European Commission's

(2014) Humanitarian Aid and Civil Protection department's disaster preparedness programme: DIPECHO Action plan. The Under-secretary for the Council of Development Planning and Action (*Subsecretaría del Consejo de Planificación y Acción para el Desarrollo – COPADE*) is implementing the Provincial Programme for Risk Reduction and Climate Change Adaptation, for the Neuquén Province. In compliance with the Provincial Law No 2713, which requires risk management to be included in local development planning, a Provincial Risk Network was formed as an institutional space for provincial and local planning.

Aichi Biodiversity Targets

Aichi Target 11 focuses on protected areas, calling for the expansion of protected areas to encompass 17% of terrestrial ecosystems and 10% of marine ecosystems to cover areas of importance for biodiversity and ecosystem services. It also calls for the effective and equitable management of ecologically representative and well-connected networks of protected areas, which are integrated into the wider landscape. These targets and the principles they represent are critical to ensuring that protected areas continue to deliver on the objectives for which they were established, as well as their vital role to reduce disaster risk for the ecosystems and local communities that depend on them.

Eco-DRR Initiatives

Box 1. "El Pozo" Ecological Reserve – Argentina

"*El Pozo*" Ecological Reserve (also known as the University City Ecological Reserve) is located in the Paraná river basin in the Santa Fe province, northeast Argentina. For the last 18 years, the *Fundación Hábitat & Desarrollo* and the *Universidad Nacional del Litoral* have been working in the riparian zone, flood plain, islands (Islas del Paraná) and the pre-delta. They have contributed to the successful conservation of biodiversity and restoration of the river ecosystem, which, through the promotion of healthy ecosystem function, are both significant in terms of reducing disaster risk.

The river and its wetlands are a water resource for livestock farming, agriculture, fisheries and transport. The importance of river restoration to recover river conditions in order to reduce flood risk and improve water quality is fundamental. Specific activities undertaken include: the restoration of lotic ecosystem vegetation affected by the great flood in 1993, protected area planning and management, biodiversity monitoring, environmental education and fire control.

Source: Fundación Hábitat & Desarrollo (2016)

Box 2. Private Nature Reserve Network – Argentina

In accordance with the CBD, the country has a target of conserving at least 10% of natural regions. Agricultural and productive lands in Argentina are largely owned by private individuals and companies, therefore private conservation must play a significant role in achieving this target. The Private Nature Reserve Network (*Red Hábitat de Reservas Naturales Privadas*) was created in recognition of the importance of such conservation initiatives and their contribution towards sustainable development in the country.

For the last twelve years, the *Fundación Hábitat & Desarrollo* —together with Argentina's National Parks Administration (*Administración de Parques Nacionales – APN*), Masisa Argentina, and the Uruguay River forestry consortium— have been working in the drainage basin of the Uruguay River, which, together with the Paraná River, forms the Río de la Plata estuary. Work has focused on the creation of a network of private nature reserves for the conservation of the riparian vegetation and important grassland areas; protected area planning and management, biodiversity monitoring and environmental education are all prevalent activities.

These riparian forests absorb and reduce water flow and provide space for flood attenuation, but the river and its wetlands are also the source of water that supports all forms of life, and are an important resource for livestock farming, agriculture, fisheries and transport. The crucial role of flood plain forests as breeding grounds for fish whilst preventing erosion, highlights the importance of such a network of private nature reserves for conservation in terms of promoting healthy ecosystems and their role in DRR.

The conservation of these wetlands not only provides effective flood defences, but also safeguards the many other benefits that these ecosystems provide. An initiative to control invasive species is also an important restoration component of the work, and includes the elaboration of a protocol to control the wild boar population, thus providing an opportunity for emblematic indigenous species found in the grassland of Corrientes to thrive. In terms of reducing disaster risk, such restoration of freshwater wetlands offers protection to life and property from flooding and drought in the River Uruguay drainage basin.

Source: Fundación Hábitat & Desarrollo (2016)

Box 3. Critical Forests and Wetlands to Combat Flooding – Argentina

In Argentina, flood control projects use the natural storage and recharge properties of critical forests and wetlands by integrating them into "living with floods" strategies that incorporate forest protected areas and riparian corridors.

Such protection forests also form part of DRR strategies in the countries, and will serve to protect infrastructure from frequent disasters including rock fall, avalanches or landslides.

Source: Quintero (2007)

3.2 Case study: Bolivia

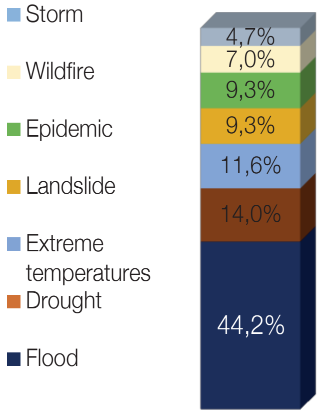
Key indicators	Unit	in % of region
Land area (km^2)	1,098,580	6.2
Forest area (km^2)[1]	565,808	6.7
Total population	10,561,887	2.6
Rural	3,368,503	31.9
Urban	7,193,384	68.1
GDP (million US$)	33,237	0.8

Period 2000–2015	Unit	in % of region
Registered hazards	43	9.2
Deaths	890	7.4
Affected people	3,259,248	4.4
Economic losses ('000 US$)	1,169,500	2.0

Source: own elaboration based on WDI (key indicators) and EM-DAT (natural hazards), 2016
Note: 1 Last data available from 2012

Natural hazards

Bolivia reported 43 hazardous events during the period 2000–2015. As seen in Figure 25, floods accounted for 44% of the total occurrence of natural hazards, followed by drought (14%), extreme temperatures (12%), landslides (9%) and epidemics (9%). The impacts of these events together resulted in 870 deaths and affected 3.2 million people.



Disaster type	Total affected	Total deaths
Flood	2,588,805	614
Drought	556,535	-
	42,772	37
Epidemic	32,666	57
Storm	18,740	20
Landslide	16,430	162
Wildfire	3,300	-
Total	3,259,248	890

Figure 25. Most common hazards in Bolivia, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

Bolivia represented only 8.3% of the total occurrence of floods in South America. Yet within the country, floods were responsible for 69% of mortalities and 79% of the population affected by reported natural disasters. Between one and two floods were registered almost every year during the period 2000–2015. According to the data presented in Figure 26, the highest number of deaths (115) and people affected (824,495) were reported in the year 2007; representing over a third of the total economic losses registered in the 16-year period.

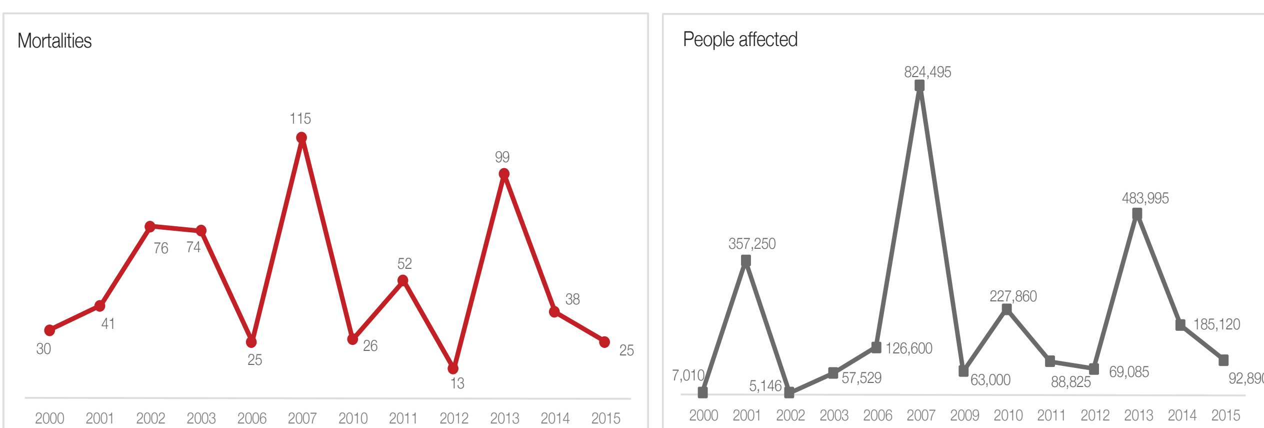


Figure 26. Total deaths and people affected by floods in Bolivia, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

With over half a million people affected, droughts represent the second largest disaster in Bolivia, accounting for 14% of the total occurrence of natural hazards in the country during the reporting period. According to available data, there are no deaths recorded and the highest number of people affected was reported in 2013 (Figure 27). Total damages reach US$ 100 million; however, this only corresponds to the year 2010. Bolivia rates among the highest countries in the region for droughts, with a 21.4% occurrence, second only to Brazil.

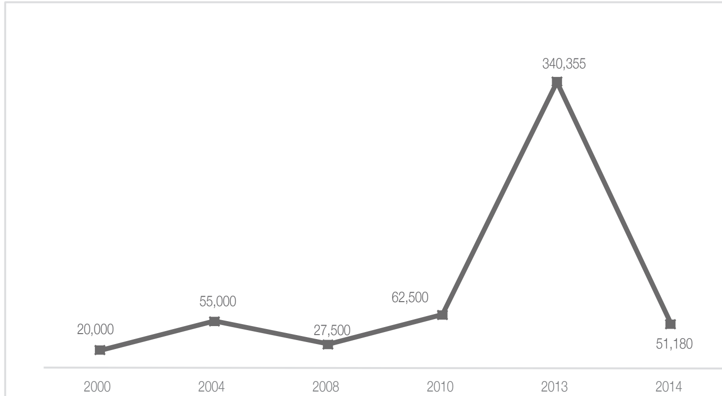


Figure 27. People affected by droughts in Bolivia, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

Bolivia also represented one of the countries with the highest occurrence of wildfires (20%), epidemics (15%), extreme temperatures (13%), and landslides (11%) in the region (Figure 28). These events represented over a third of the natural hazards reported by the country, yet their impact resulted in less than 3% of the population affected by disasters. In terms of mortalities, however, landslides accounted for 18% of the total, resulting in the second cause of deaths associated with disasters in the country.

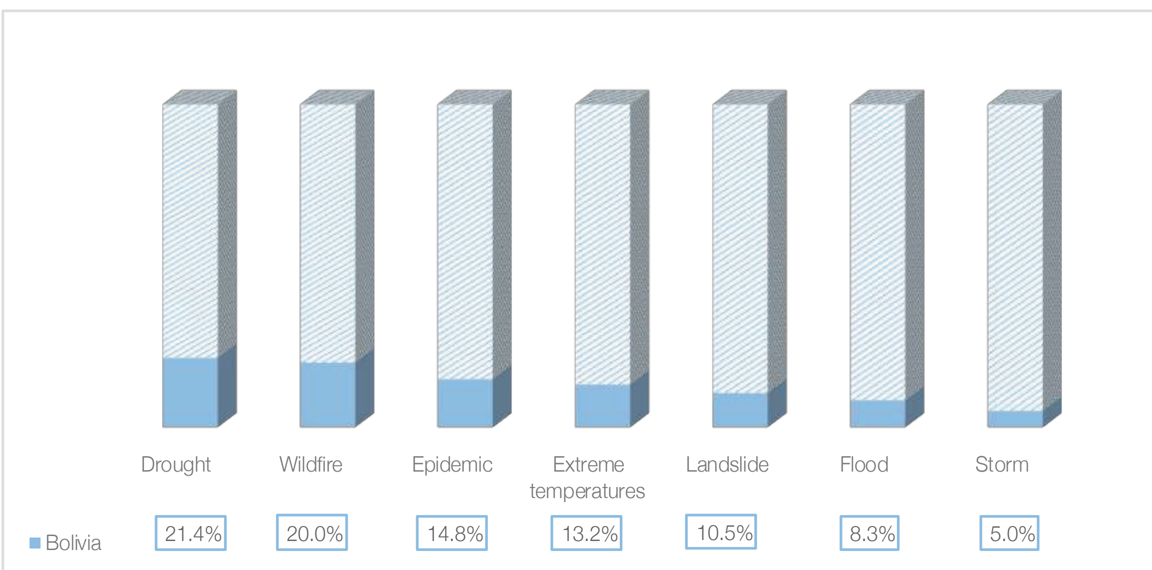


Figure 28. Bolivia's proportion of main hazards in the region, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

Policies and strategies related to Eco-DRR

Biodiversity status, trends and threats

According to the country profile on the CBD, Bolivia is among the 15 most biodiverse countries in the world. Forest cover in Bolivia represents approximately 53% of the national territory (FAO, 2015b), but **deforestation** is among the main causes of biodiversity loss in Bolivia. The main land uses contributing to deforestation and forest degradation include conversion to livestock pasture, mechanised agriculture and small-scale agriculture. The most affected areas are the Yungas ecoregion, the humid south-western Amazon forest and the dry forests of Chiquitano and Chaco. It is estimated that one-tenth of Bolivia's forests has been lost since 1990. Notably, deforestation levels in protected areas and in the territories managed by Indigenous Peoples and *campesino* communities are significantly lower than outside them.

In 2010, Bolivia adopted the historic **Law on the Rights of Mother Earth**. This was followed in 2012 by the adoption of the Framework Law on Mother Earth and Integral Development for Living Well, focused primarily on climate change mitigation and adaptation, although stressing the importance of implementing holistic measures for biodiversity and cultural conservation to "live well". The Framework Law on Mother Earth also specifies an objective to prevent and reduce risk and vulnerability to the people of Bolivia. Against this background, the **Patriotic Agenda 2025** was adopted in 2013 as a comprehensive programme for achieving sustainable development in the country.

In 2014, Bolivia began implementation of the **Mitigation and Adaptation Mechanism for Integrated and Sustainable Management of Forests and Mother Earth**, as a fundamental public policy to contribute to reducing the loss, degradation and fragmentation of its ecosystems. The mechanism is implemented in regional and/or macro-regional territories in the country.

Bolivia has developed the technical document "**Risk Management for the Water and Environment**", designed to mainstream disaster risk management in the development plans of the Ministry of Environment and Water (MMAyA).

Bolivia has also implemented management tools, such as the Agricultural Sector Development Strategy 2014–2018, which identifies the environment as a crosscutting issue and refers to reduction of natural disaster impacts in the agricultural sector, through the **prevention and mitigation of disasters**, emergency response, and recovery and reconstruction. It is also acknowledged that a crucial element of this management relates to the participation of different sectors and society in general[12].

Fifth National Report

Throughout Bolivia's Fifth National Report to the CBD, the environment, and ecosystems in particular, are recognised at multiple levels. Although the text does not strongly acknowledge the role of ecosystems for DRR, Bolivia does include hazards, which indicates that there is scope for increased activities on the ground for Eco-DRR. Despite the absence of specific targets related to DRR, in terms of natural hazards, Bolivia's fifth national report does make specific reference to the principal **hazards** identified in the previous section: flood, drought and temperature extremes.

The NR5 highlights that climate variability and climate change pose significant threats to both livelihoods and species, highlighting increased risk of flooding, drought, temperature extremes and climatic events. Projected climate change impacts are expected to be very strong for biodiversity, especially in the Altiplano where high desertification is projected, owing to the reduction in precipitation and temperature variability. Whereas in the lowland regions, it is agricultural expansion, not climate change, that represents the main threat to biodiversity.

Bolivia's fifth national report explicitly recognises biodiversity conservation as fundamental for resilience, a key element for CCA. Highlighting the important role of landscapes for species and community connectivity, and ecological processes for the conservation of nature and its adaptive capacity; also acknowledging ecological corridors as essential for migration of species displaced by a changing climate.

[11] Ley Marco de la Madre Tierra (Ley No 300, 2012).

[12] CBD (n.d.). Bolivia – Country Profile (https://www.cbd.int/countries/default.shtml?country=bo

In Art. 2 of Decree No. 1696, Bolivia defines adaptation as the adjustment in the life systems of Mother Earth in response to climate change impacts. Therefore, it promotes conditions, capacities and forms for prevention and minimising damages and risks associated with it; and promotes opportunities and benefits for protecting and defending Mother Earth in all its forms. Biological diversity is recognised as an important consideration for CCA, also acknowledging the essential role of agrobiodiversity.

Bolivia has adopted a number of legislations and mechanisms to implement the country's vision for biodiversity conservation and sustainable development:

- Law on the Rights of Indigenous Peoples (2007) (Bolivia was the first country in the world to adopt this UN Declaration as national law. Bolivia recognises the customary use of biological resources by Indigenous Peoples and *campesino* communities in all legislations and regulations on this subject).
- Law on the Rights of Mother Earth (2010)
- Framework Law on Mother Earth and Integral Development for Living Well (2012)
- Plurinational Fund for Mother Earth (established under the Framework Law on Mother Earth and Integral Development for Living Well to generate financial support for managing the country's life-systems and is mainly linked to in situ conservation)
- Patriotic Agenda 2025 (2013)
- Act on Ancestral Traditional Bolivian Medicine (2013)
- Education Act (2010)
- **Joint Mitigation and Adaptation Mechanism for the Integral and Sustainable Management of Forests and Mother Earth** (2014) (this is Bolivia's alternative to the UN REDD+ Programme)
- Strategy on Gender Complementarity (for Living Well) (within the context of the National Programme on Bioculture)
- Integrated Programme for Solid Waste Management (2011–2015)
- Master Plan for the National System of Protected Areas
- National Afforestation and Reforestation Plan Andean Ecosystems Strategy

Some of the **challenges** highlighted in the fifth national report relate to the implementation of EbA in Bolivia, which include threats posed by climate change and agriculture; specifically highlighting that the majority of soils suitable for forests are currently utilised for agriculture, which is a significant livelihood activity and as such provides immediate benefits. The management of residual waters and toxic residuals was highlighted as a necessity, as there is no system for residual water, this means effectively that contamination often goes directly into rivers and water sources, thus debilitating water ecosystem integrity. As such, these affected **natural water sources lose their integrity**, and therefore the protection offered by them is diminished. Their capacity for providing a continuous supply of quality water is impeded and they are unable to safeguard against crop failure and damage in times of drought.

Bolivia has experienced an increase in protection of areas such as **Ramsar sites** from 7,894,472 ha to 14,842,405 ha in 2013, which demonstrates a willingness to preserve water sources in the country, and although not necessarily including DRR or CCA, the inherent benefits of protecting these wetland sites and other protected areas for DRR is evident.

National Biodiversity Strategy and Action Plan (NBSAP)

Adopted in 2001, Bolivia's first NBSAP consists of 5 key components: (i) conserve ecosystems, species and genetic resources of ecological, economic and cultural importance; (ii) attract investment in biodiversity products and functions; (iii) develop national capacity for biodiversity management; (iv) develop local management for biodiversity conservation and sustainable use; (v) education, awareness-raising, communication and social control regarding sustainable biodiversity management.

Bolivia began revising and updating its NBSAP in 2014, to cover the period 2015–2025. Bolivia has included some EbA-related aspects in its NBSAP (although EbA is not mentioned explicitly), and has a dual focus on both people and nature:

- Protected Areas: 44% of national watersheds protected
- Spatial Plan Integrated Management: better management of 7 protected areas
- Restoration/rehabilitation: restoration of biodiversity, improving soil use, reducing deforestation, sustainable livelihoods of local communities and indigenous communities; 169 ha reforestation
- Build adaptive capacity, technical capacity, education and awareness: capacity building in indigenous communities
- Government/policy planning and regulatory frameworks/mainstreaming of biodiversity values into national policy: Planned for 2020: 115 policies approved for biodiversity management
- Diversify agriculture, soil conservation, improve water efficiency, sustainable land management (SLM), sustainable forest management (SFM): Improvement in food security, 2,598 families; 381 tm seeds; 4,041 ha soils with agroecological systems
- Manage threats to biodiversity, e.g. invasive species (AIS): Only threat to humans is the A. Aegypti species
- Economic analyses, e.g. cost-benefit, valuation of ecosystem services: mentioned in the NBSAP
- Natural resource management (fisheries, forests): from 2014 forest management, one territory and ten in progress

Aichi Biodiversity Targets

Based on Pillar 6 of the Patriotic Agenda 2025 on "diversified sovereign production and holistic development free from the dictates of capitalist markets", Bolivia is promoting the optimal usage of water for irrigation, a transition to additional systems for intensive livestock production, **integrated water resources and watershed management**, among other actions.

In 2013, the Coordination Unit of the National Council on Ecological Agricultural Production provided technological support to 6,000 producers to plant 8,500 hectares of organic crops. Bolivia also intends to develop actions to protect the genetic heritage of agricultural biodiversity and prohibits the introduction, production, use, release into the environment and commercialisation of genetically modified (GM) seeds.

A collection of 16,006 accessions (seeds) of plants (e.g. beans, quinoa, lupine, cañahua, amaranth, potatoes, peppers, achojchas) is protected and preserved. The **Agricultural Sectoral Development Plan** (2014–2018) "Towards 2025" presents an assessment for the years 2010–2013 and confirms an increase in the number of gene banks during this period.

National Disaster Management Plans

The Law for Disaster Risk Reduction and Emergency Actions[13] came into force in 2000, with the formation of a corresponding National System for Risk Reduction and Disaster Response (SISRADE), and the National Council for Risk Reduction and Disaster Response (CONARADE), for implementing this law.

[13] Ley Nº 2140.

Box 4. Traditional knowledge for adapting productive systems to climate change – Bolivia

Amazonia Services have contributed towards sustainable productive development and CCA, with the re-introduction and promotion of an ancient system of soil management (*Waru Waru*), to protect against soil erosion of the Amazon plain and gallery forests in the Santa Ana del Yacuma Municipality, in the Beni Department, north-eastern Bolivia. This agricultural technique was developed by pre-Hispanic peoples in the Andes region of South America, from Colombia to Bolivia; it reportedly dates back some 3,000 years.

Due to the ecological and climatic diversity a wide variety of crops are grown in Bolivia. Families depend largely on crops; increasingly, crop productivity is threatened by frequent and intense weather events, including rising temperatures and declines in rainfall. The project therefore focuses on using traditional knowledge to improve the quality of livelihoods and strengthen community resilience, as well as improve water management techniques, and natural resource conservation. One component of the project relating to food security was to diversify productivity through the use of plant genetic resources for food and agriculture. This implied the promotion of growing various crop types, including functional and high-quality crops, and the recovery and propagation of local germplasm.

Key results relevant to Eco-DRR from this traditional irrigation technique include: improved soil management, which has increased soil stability and soil biodiversity, thereby reducing soil compaction and erosion. This, in turn, has led to increased productivity and carbon sequestration, contributing to the conservation of valuable ecosystem services.

Source: Fundación Hábitat & Desarrollo (2016)

A similar example of implementing this technique in fallow land in the basin of the Mamoré River ––in the San Ignacio de Moxos Municipality, in the Beni Department–– has experienced similar success, and received public sector support from Bolivia's Ministry of Environment and Water (MMAyA). *Waru Waru* was used in two vulnerable municipalities in the Mamoré River basin, for risk management, CCA, improving food security, and strengthening the livelihood options for local populations. The project revived an ancestral system of cultivation and irrigation, forming a patterned system of raised cropland and water-filled trenches.

This system captures water when there are droughts and drains away water when there is too much rain, which not allows crops to be effectively irrigated all year round, but also acts as an important buffer to ecosystems and communities in times of flash flooding.

Therefore, the resurgence of this ancient farming system with local communities improves income opportunities by promoting crop production in periods of flood and drought, and also promotes adaptation to climate change, as well as productive development to manage and reduce disaster risk posed by floods and drought in communities in the San Joaquín and San Ignacio de Moxos municipalities.

Regarding other ecosystems within Bolivia, Andean **glaciers** have displayed continued recession, with the most pronounced retreats beginning in the early 1980s. Glaciers and the water they provide are intimately associated with indigenous culture, customs and religion. Many of these glaciers exhibit some of the most rapid mass and surface area losses in the world (Painter, 2007).

The region is faced with diverse climate impacts, especially, for instance, in the Altiplano extending from the equator to central Chile, and the high plateau of Peru and Bolivia, these areas depend, in large measure, on **meltwater** from snow or ice. The loss of glaciers, snow and associated meltwater is of particular concern as this meltwater provides drinking water for a large proportion of the region's population, as well as water for irrigation and hydroelectric dams. Rapid changes in the climate can destabilise glacial lakes leading to sudden floods, and destabilise snowpack causing avalanches.

Glacial retreat presents a serious problem, not least for people inhabiting arid climates in the Andes, who rely on glacial melt for their water supply, especially during dry spells and periods of drought. Farmers irrigate their crops by channelling meltwater, without which livelihoods are severely affected.

Since 2008, Bolivia, Ecuador and Peru, with the support of the World Bank, have been implementing a project to adapt to the impacts of receding glaciers in the Tropical Andes (Adaptation to the Impact of Rapid Glacier Retreat in the Tropical Andes), see Box 5.

The Swiss Agency for Development Cooperation (SDC) supported the development of DRR activities within the **MMAyA**. For instance, the Vice-Ministry of Water Resources and Irrigation (VRHR) coordinated the following national programmes: *MiAgua (Más Inversión para Agua)* and PROAR (*Programa Agua y Riego para Bolivia*). And, significantly, the **Farming and Climate Change Risk Management Unit** within the Vice-Ministry of Rural Development and Farming (VDRA) incorporates DRR and CCA into their planning and work instruments, thereby reducing disaster risk.

The SDC also developed and implemented its "Guide for Integrating Climate, Environment and Disaster Risk Reduction" (CEDRIG), which, as the name suggests, systematically integrates climate, environment and DRR into development cooperation and humanitarian aid to increase resilience of ecosystems and communities.

DRR and CCA projects have been implemented by the World Bank, CARE, and the Swiss Cooperation in the eastern Andes, Department of La Paz, *Adaptación al Impacto del Retroceso Acelerado de los Glaciares en los Andes* (PRAA) Disaster Risk Reduction for Climate Change Adaptation pilot activities in the Municipalities of Batallas and Palca. It was reported that the crops were made more resilient, and although it is unclear exactly how this was achieved, it is likely linked to plant genetic diversity and therefore serves as a good example of the role of biodiversity in DRR.

From 2005–2014, the Swiss Cooperation implemented a DRR project for prevention, to build awareness and strengthen DRR capacities for communities and organisations in six Departments:

La Paz, Oruro, Cochabamba, Chuquisaca, Potosí and Tarija. One of the project components focused on reducing climate risks in agriculture, which promoted the application of agroecology practices for prevention, mitigation and adaptation.

Additionally, Swiss Cooperation partners have also been implementing projects focused on DRR and CCA, for instance:

- Between 2011–2012, *Fundación Agua Tierra Campesina* (ATICA) implemented a project which focused on reducing disaster risk and CCA, through the strengthening of local governance in the municipalities forming the Commonwealth of Cintis. The capacities of women's groups were also strengthened to confront climate change impacts in the Andean zone of the Department of Cochabamba (2011–2013).
- ATICA, in alliance with PROSUCO and PROFIN, implemented the Integrated Agro-climatic Risk Management project (*Gestión del Riesgo Agroclimático Integral* – GRAI) in the Commonwealth of Cintis.
- HELVETAS Swiss Intercooperation has been implementing DRR and CCA projects in Bolivia since 2010. The most relevant initiatives relate to the promotion of agroecological production practices for prevention, mitigation and adaptation.

Box 5. EbA within a DRR strategy in the Andes – Bolivia, Ecuador and Peru

The World Bank multilateral project "Adaptation to the Impact of Rapid Glacier Retreat in the Tropical Andes" (2008–2014) –funded by the Special Climate Change Fund (SCCF)– focused on CCA using an ecosystem-wide approach.

Rising temperatures and shrinking glaciers are exacerbating existing risks of avalanches, rock falls, and floods in the Andes. The project supported regional efforts in Bolivia, Ecuador and Peru, to define adaptation measures to meet the anticipated impacts from climate change in the Andean highlands and in prioritised Andean-origin river basins highly impacted by extreme weather events.

The multilateral project developed approaches for the integrated reduction of natural hazards, and included a combination of soil restoration in the Andean highlands, assisted by climate-resilient irrigation techniques, and alternative crops and best practices in agriculture. It contributes to the prevention of landslides and flash floods due to climate change-induced accelerated glacier melting. The CCA strategy included integrated climate-proof risk management measures, such as the ecosystem-based approach of maintaining and improving the functionality of protection forests.

Source: World Bank (2014)

3.3 Case study: Chile

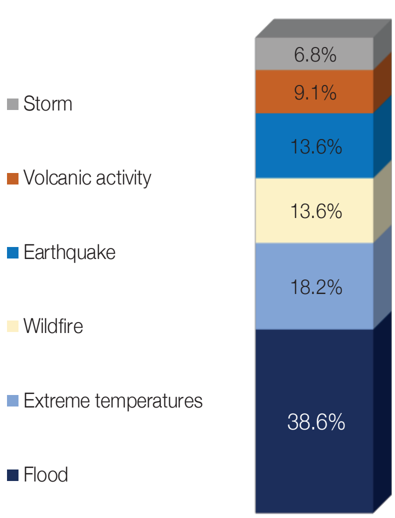
Key indicators	Unit	in % of region
Land area (km^2)	756,100	4.3
Forest area (km^2)[1]	163,062	1.9
Total population	17,762,647	4.3
Rural	1,890,656	10.6
Urban	15,871,991	89.4
GDP (million US$)	258,017	6.2

Period 2000–2015	Unit	in % of region
Registered hazards	44	9.5
Deaths	917	7.7
Affected people	4,261,095	5.8
Economic losses ('000 US$)	32,094,000	56.1

Source: own elaboration based on WDI (key indicators) and EM-DAT (natural hazards), 2016
Note: 1 Last data available from 2012

Natural hazards

Chile reported 44 hazardous events during the period 2000–2015, accounting for 10% of the disasters registered in the region. As seen in Figure 29, floods accounted for 39% of the total occurrence of natural hazards, followed by extreme temperatures (18%), wildfires (14%), earthquakes (14%), volcanic activities (9%) and storms (7%). The impacts of these events together resulted in 917 deaths and 4.2 million people affected.



Disaster type	Total affected	Total deaths
Earthquake	3,262,040	592
Flood	886,569	252
Extreme temperatures	76,100	6
Volcanic activity	19,100	-
Wildfire	12,767	20
Storm	4,519	47
Total	4,261,095	917

Figure 29. Most common hazards in Chile, 2000–2015 | *Source: Own elaboration based on EM-DAT (2016)*

During the period 2000–2015, earthquakes and floods had the most significant impact in the country. Earthquakes were responsible for 65% of mortalities and 77% of the population affected by disasters. These events were reported in 2005, 2007, 2010, 2012 and 2014 (Table 10); yet the earthquake of 2010 had the worst impact with 562 deaths, 2.6 million people affected and US$ 30 billion in damages.

Table 10. Earthquake's impact in Chile, 2000–2015

Year	Total deaths	Total affected	Total damage ('000 US$)
2005	11	27,645	5,000
2007	12	25,155	100,000
2010	562	2,671,556	30,000,000
2012	1	24,297	100,000
2014	6	513,387	100,000
Total	592	3,262,040	30,305,000

Source: Own elaboration based on EM-DAT (2016)

Floods, on the other hand, occurred almost every year, accounting for 21% of people affected and 28% of the total mortalities associated with disasters in the country (Figure 30). The impact resulted in 252 deaths, 886,569 people affected and US$ 265 million in economic losses.

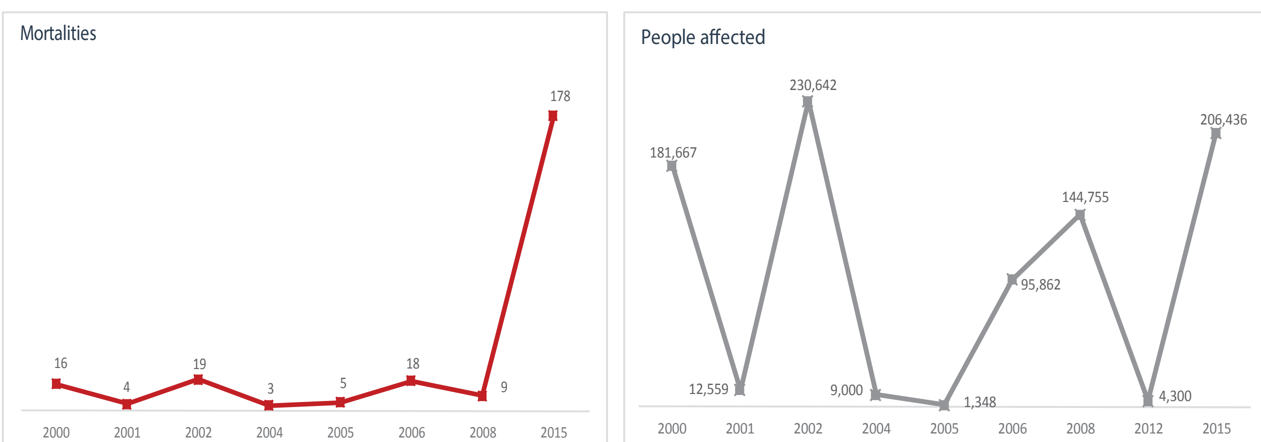


Figure 30. Total deaths and people affected by floods in Chile, 2000-2015 | *Source: Own elaboration based on EM-DAT (2016)*

Whilst Chile represented only 10% of the total occurrence of natural hazards reported in South America, it is interesting to note that the country experienced the highest number of wildfires in the region (40%); and also reported one of the highest occurrences of earthquakes (23%), extreme temperatures (21%) and volcanic activity (17%) during the period 2000–2015 (Figure 31).

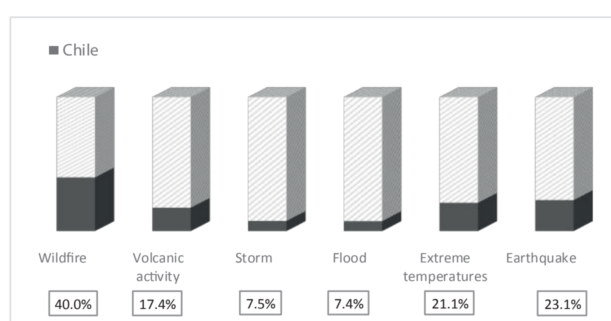


Figure 31. Chile's proportion of main hazards in the region, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

Biodiversity status, trends and threats

According to the country profile on the CBD, Chile is a long and narrow country located to the west of the Andes, between latitudes 17° and 56°S and longitudes 66° and 75°W. Consequently, the country's landscapes are extremely varied, consisting of desert, forest, valleys, mountains and several distinct ecosystems. Chile possesses around 30,000 species, 25% of which are endemic. The central and southern zones of the country are considered a global biodiversity hotspot and among the most threatened. Chile's Atacama Desert is considered the driest in the world, while the Valdivian temperate rainforests, dominated by evergreen angiosperm trees, are unique to southern Chile and Argentina on the South American continent.

Chile is also located within the "Pacific Ring of Fire", an area prone to earthquakes and volcanic eruptions. It also claims around 480,000 square miles of Antarctica as part of its territory, however this claim is currently suspended under the Antarctic Treaty. The forestry, fisheries, agriculture and tourism sectors depend directly on renewable natural resources and account for 9.7% of the GDP while directly providing at least one million jobs.

In general, ecological conditions are better in southern Chile and worse in the country's central zone. In the northern zone, activities conducted by the mining and agricultural sectors are negatively impacting the status of rivers and lakes and coastal wetlands. The country's terrestrial ecosystems have experienced a major loss in native forest cover, particularly in the central zone with rates reaching between 3.5% and 4.5% annually. Over the last two decades, ecosystems located in the coastal zone of Maule (VII Region) and Bio Bío (VIII Region) lost about 26% of their coverage. During the same period, losses of 10% to 20% have been recorded in 11 other ecosystems in the central zone, mainly due to the establishment of new forest plantations in these areas. Anthropic ecosystems meanwhile have come to occupy 12% of the national territory, transforming natural ecosystems, forests, scrub, deserts and steppes into residential areas, roads and productive land.

The main threats to biodiversity are changes in land use due to activities related to the forestry and agricultural sectors. Other threats are associated with urbanisation, invasive alien species, forest fires, climate change and water extracted for mining and agricultural activities in the northern zone of the country [14].

Forest covers approximately 44% of Chile's national territory (FAO, 2015b). Chile is the only country in the region that experienced a net gain of between 0.5–5 million ha in forest cover during the 1990–2015 period (FAO, 2015b).

Policies and strategies related to Eco-DRR

Regarding disaster risk reduction, Chile signed the Hyogo Framework for Action 2005–2015 and created a national multisectoral DRR platform called *Mesa Temática para la Gestión del Riesgo y Reducción de Riesgos de Desastres*[15]. Participants to the platform belong to the public sector, United Nations agencies, financial institutions, regional bodies, the civil society, the private sector as well as representatives of the academic and scientific community. The Ministries involved are: Ministry of Interior (Steering Committee), Education, Housing and Town Planning, Environment, Public Works, Finance, Social Development. Other public and private institutions can be invited to special sessions (in Cordero *et al*., 2014: 9-10).

The National Office of Emergencies (ONEMI) as part of the Ministry of Interior and Public Security is the

[14] CBD (n.d). Chile – Country Profile (https://www.cbd.int/countries/default.shtml?country=cl)
[15] Ministerio del Interior y Seguridad Pública: Acta de Constitución de la Plataforma Nacional de Reducción del Riesgo de Desastres en Chile, 2012. http://www.preventionweb.net/files/28726_actadeconstitucindelaplatafor manaci.docx

institution in charge of planning, coordinating and implementing activities for the prevention, mitigation, warning, response and rehabilitation required for the National System of Civil Protection's functioning as response to threats, emergencies, disasters and catastrophes; in order to protect people, property and environment at national, regional, provincial and communal levels[16] (in Podvin *et al*., 2016).

A law pending approval favours the establishment of a National Emergency and Civil Protection System and the creation of a National Civil Protection Agency to take over the role of the ONEMI in the future. To date the law had not yet passed the Senate[17]. Once the law enters into force, the development and implementation of regulations will take further time.

Chile has a National Policy for Disaster Risk Management, which was developed by a National Platform established for Disaster Risk Reduction led by ONEMI, whose first mission was the formulation of a policy that allows the development of comprehensive disaster risk management in the country.

The objective of this policy is to grant the State of Chile, an instrument or guidance framework, which allows the development of comprehensive disaster risk management where general polities are articulated in transversal policies and sectoral policies, and where the prevention, response and disaster recovery actions take place within a sustainable development framework (ONEMI, 2014). Within the scope of this policy, it states that there should be a comprehensive disaster risk management, including, in the future, other planning and/or spatial delimitation units such as watersheds, ecosystems, macro-zones and biodiversity, among others (*Ibíd*, p. 33 in Podvin *et al*., 2016).

16 http://www.onemi.cl/mision-y-vision/
17 http://www.latercera.com/noticia/nacional/2014/04/680-575856-9-las-similitudes-y-diferencias-entre-la-onemi-y-el-proyecto-de-agencia-nacional.shtm

Fifth National Report

In its Fifth National Report, Chile specifies targets related to Eco-DRR, principally, the capacity of wetlands to act as buffer zones in the VII Region del Maule (PRES *Constitución*, PRES *Licantén -borde costero de Iloca, Duao y La Pesca- y PRES Pelluhue-Curanipe*) and the VIII Bio Bío Region (18 plans in three different zones: North (Cobquecura, Caleta Perales and Dichatoamong among others); Centre (Penco-Lirquén, Talcahuano and Caleta Tumbes, among others) and South (Llico, Lebu and Isla Mocha, among others).

The NR5 also highlights cyclone, flood/storm surge, drought, food security, fire, erosion and water security as relevant natural hazards for the country.

Challenges highlighted in the NR5 related to the implementation of EbA in Chile include:

- lack of information relating to marine ecosystems
- terrestrial ecosystems in central Chile are especially vulnerable to climate change
- there are no indicators at country level for preserving genetic resources (Aichi 13); land use change has a significant impact

Challenges related to the implementation of DRR in Chile include:

- There are incentives for deforestation (farm and industry) from diesel imports (US$ 605 million) that affect ecosystem based approaches for DRR; however, in 2015 there was an estimated 35% reduction in the import of diesel
- Fisheries have the potential to increase by 12,000 tonnes per year, and there is a need for monitoring studies for invasive species
- 32 protected areas require proper management

Lessons learned:

- Urgent need to protect marine and terrestrial areas that are biodiversity hotspots and harbour a wide diversity of habitats that are not currently protected
- more basic research is needed to determine

which areas to protect and which need a state regulation for preserving genetic diversity

- need for state regulation to protect the ecosystems that provide human wealth (Aichi 14)
- there are several restoration projects but there is a need for proper coordination for their implementation
- It is necessary to eliminate financial, institutional and operational barriers to increase the awareness and protection of biodiversity and ecosystem services
- Need to improve the conservation and restoration of degraded ecosystems and eliminate perverse incentives

National Biodiversity Strategy and Action Plan (NBSAP)

Chile adopted its first National Biodiversity Strategy in 2003, which proposed the following strategic orientations: (i) ensure ecosystem conservation and recovery to significantly slow the loss of biological diversity before 2010; (ii) ensure the preservation of species and genetic heritage; (iii) promote sustainable production practices; (iv) strengthen inter-institutional and intersectoral coordination for the integrated management of biodiversity; (v) establish formal and informal mechanisms required for the optimal management of biodiversity; (vi) strengthen environmental education, public awareness and access to information on biodiversity; (vii) strengthen and coordinate research; and (viii) consolidate funding mechanisms. Only 50% of the actions in the Strategy have been implemented for reasons associated with an absence of political will, change in priorities among the bodies responsible for implementation, lack of coordination and/or agreement and a lack of financial resources.

Activities are firmly in progress to revise the Strategy, which will contain a vision to 2030 and consider the current global biodiversity agenda. The overarching strategic goals will focus on protection, restoration and sustainable use, with sub-strategies focused on participation, institutional, financial and human capacity-building, knowledge strengthening and access and benefit-sharing. Chile also intends to develop resource mobilisation strategies and indicators, as well as Regional Biodiversity Strategies.

Chile has included EbA-related aspects in its NBSAP, which is focused on both people and nature (although EbA is not explicitly mentioned):

- <u>Protected Areas:</u> 20% of terrestrial protected areas; 4.3% marine protected areas between 2009–2014; nine terrestrial areas (189,074.5 ha) and three marine areas (15,000,000 ha)
- <u>Restoration/rehabilitation:</u> 53 ha of the native tree species coigue (*Nothofagus dombeyi*) for project to restore 3,000 ha eucalyptus
- <u>Build adaptive capacity, technical capacity, education and awareness:</u> publication of books, printed materials, environmental education to students, for informing people about conservation; strengthening capacities with certified environmental educational services from 375 in 2009 to 876 in 2013
- <u>Government/policy planning and regulatory frameworks/mainstreaming of biodiversity values into national policy:</u> *Política de Áreas Protegidas Política y Estrategia Nacional para Restauración Ecológica en Áreas Silvestres Protegidas del Estado (2012)*
- <u>Diversify agriculture, soil conservation, improve water efficiency, sustainable land management (SLM), sustainable forest management (SFM):</u> *Acuerdos de Producción Limpia (Estudio de Caso 6) y la iniciativa Vino, Cambio Climático y Biodiversidad (Estudio de Caso 7)*
- <u>Natural resource management (fisheries, forests):</u> artisanal fisheries are self-regulated by fisher folk, whereas there are problems with foreign / non-local commercial fisheries that use unsustainable nets in the *Reserva Costera Valdiviana* (RCV)
- <u>REDD+:</u> mention of REDD+ and the country's collaboration with the UN-REDD Programme, where projects are ongoing.

Additionally, as part of Initiative 20x20, Chile has committed a total of 500,000 hectares for restoration by 2020; this will be achieved through the Ministry of Agriculture.

Aichi Biodiversity Targets

Awareness-raising activities are being carried out through an **afforestation** programme begun in 2010 to be implemented until 2018. The programme's target is to **plant 17 million trees** (approximately 50% being native species) with the participation of municipalities, businesses, educational institutions, organisations, neighbourhoods and the general public.

Chile recently joined the World Bank **WAVES Initiative**, and was also selected by the UN to carry out pilot projects on **ecosystem accounting**.

As a signatory to various free-trade agreements, Chile is obliged to improve the sustainability of some of its products in accordance with the provisions of these agreements. In the forestry sector, a culture of certifying production processes by productive enterprises exists nowadays, complementing the international rules and standards governing sectors linked to the export of natural resources. In the field of waste management, the concept of Extended Producer Responsibility (EPR) has been introduced as an environmental protection strategy.

Concerning **invasive species**, success has been achieved in eradicating the rabbit on Santa Clara Island while progress is being made towards its eradication in the Humboldt Penguin National Reserve. Meanwhile the most harmful alien species (e.g. beaver, mink) are increasing. A Resolution was adopted in August 2013 on the creation of an Operations Committee for the Prevention, Control and Eradication of Invasive Alien Species, which will be coordinated by the Ministry of the Environment.

Regulations have been prepared and are currently being formalised for developing plans for the recovery, conservation and management of classified wild species. Plans have been proposed for the Hummingbird of Arica (XV Region), Little Tern (XV Region, I Region, II Region), Ruddy-headed Goose (XII Region), various amphibians, Darwin's Fox (VIII Region, IX Region, XIV Region, X Region) and five cactus species (XI Region).

National Adaptation Plan

To address climate change adaptation Chile developed the National Climate Change Adaptation Plan, as well as nine sector specific plans, all aligned with national priorities. Until now, two sectoral plans have been developed and approved: 1) Forestry and agriculture plan and 2) Biodiversity plan. The other seven plans are related to: water resources, fisheries and aquaculture, health, energy, infrastructure, cities and tourism (Government of Chile, 2015)[18].

The sectoral Plan for Biodiversity is based on sustainable management and ecosystem conservation and restoration, through measures aimed at reducing anthropogenic and bioclimatic stresses and increasing capacity in the fields of research, monitoring, information and training. In this light, the Ministry of Environment is promoting the creation of a task force to address matters on ecological restoration and develop an implementation programme. Chile is a participant both of the UN REDD+ Programme and the UNDP Biodiversity Finance Initiative (BIOFIN).

Protected Areas

Work on protected areas is advancing; however, there exist significant gaps in ecosystem representation. At present, terrestrial protected areas comprise 20% of the national territory, while marine protected areas comprise 4.3%, however, 99% of this area corresponds to only one marine protected area (Motu Motiro Hiva Marine Park). In addition, the management effectiveness of the marine protected areas has been determined to be low. A positive development has been the recent creation and implementation of the Committee on Protected Areas.

[18] For more information on policy analysis related to climate change adaptation, and opportunities and gaps related to EbA for CCA and DRR, see Podvin et al., 2016.

There is insufficient information to provide an account of the loss and/or alteration of marine ecosystems and component species in Chile. Moreover, no official classification system exists to properly plan and manage these ecosystems. The global Ocean Health Index ranks the conservation status of Chile's marine biodiversity as "good"; the same status is, however, not applicable to fisheries and aquaculture resources that are presently overexploited. Oceanic islands, such as the Juan Fernandez Archipelago, considered a biodiversity hotspot, face serious conservation problems due to the introduction of invasive alien species, the absence of integrated land management and sustainable resource management, among other factors. As for inland aquatic ecosystems, the absence of data and systematised information and monitoring also prevent a complete picture from being formulated. These factors are key in evaluating the potential for restoration and preservation of coastal habitats in Chile, forming bioshields along tsunami affected coastline that don't just protect, they also provide an essential way of generating a sustainable income.

Eco-DRR Initiatives

Box 6. Community-based Adaptation to Climate Change – Chile

To help protect communities from disasters and tackle the adverse effects of climate change, the Ecosystems Protecting Infrastructure and Communities (EPIC) project investigates the role that healthy ecosystems play in reducing disaster risk and supporting community-based adaptation (CbA) to climate change. EPIC is a five-year initiative funded by Germany's Federal Ministry of the Environment, Nature Conservation, Building and Nuclear Safety's International Climate Initiative.

Chile is one of the seven countries participating in this project, which focuses on the Biosphere Reserve Nevados de Chillán – Laguna del Laja, located in the VIII Biobío Region – a global biodiversity hotspot. The reserve is an ecological transition area, located on the limit of two globally threatened ecosystems: the Mediterranean Shrubland of central Chile considered as one of the most vulnerable environments on the planet, and the Valdivian Temperate Rainforest.

In Chile, EPIC implementation is from 2013–2017, and is coordinated by IUCN, working closely with Chile's Ministry of Environment, Regional Ministerial Secretary of the Biobío Region (SEREMI Biobío) and the Swiss Federal Institute for Forest, Snow and Landscape Research (SLF); the project has also worked in some activities with TERRAM, Universidad Austral de Chile and the University of Chile. It sets out to investigate the protective role of native forest in the face of hazards and subsequent disasters caused by avalanches; and where necessary, explores alternate management and conservation strategies for these forests.

For Chile, there are three main components: 1) demonstrate the importance of environmental management; 2) Strengthen capacities, increase awareness and communicate about the potential for environmental management (at local, regional and national levels) and 3) disseminate through multi-stakeholder platforms, lessons learned and practical solutions which can be replicated or used as input for developing programmes and public policies.

A vulnerability assessment was carried out based on local perceptions in the Valle Las Trancas, which identified drought, increased warming, wildfires, precipitation accompanied by strong winds, and avalanches, as the key phenomena aggravated by climate change in the Biosphere Reserve. To confront these risks, local innovations based on local knowledge, experience and capacities were proposed, which include the conservation and management of native forest, promotion of ecotourism, integrated management of the Biosphere Reserve, use of sustainable energy, and promoting sustainable water use. Importantly, it is local stakeholders who are implementing these actions, under the leadership of public institutions.

Sources: https://www.iucn.org/about/work/programmes/ecosystem_management/epic_project/

UNDP

In 2013–2015, UNDP, along with the European Commission's (2014) Humanitarian Aid and Civil Protection department (ECHO), implemented a project to develop capacities for disaster risk management. In the period 2015–2016, UNDP is implementing a project on Disaster Risk Management at the municipal level.

Other DRR projects until 2014 can be found in the following table:

Table 11. Climate change adaptation and disaster risk reduction projects in Chile

Disaster Risk Reduction[19]	
Strengthening of the Regional System of CivilProtection and the Reduction of Quake and Tsunami Risks in the North of Chile	Fortalecimiento del sistema regional de protección civil y reducción de riesgos ante sismos y tsunamis en la zona norte de Chile http://www.cruzroja.cl/dipecho/ PNUD 2012. Cuadernillo 2: Gestión Local y Desarrollo de Capacidades para la Reducción del Riesgo; http://www.pnud.cl/prensa/4.asp
Risk Management Working Group in the Valley of Itata: Building up resilience	Territoires Solidaires. http://www.territoires -solidaires.org/public/docs/Itata/Resumen_Valle_Itata.pdf Asociación de Municipalidades del Valle del Itata, AMVI. 2012. http://www.eird.org/wikiesp/images/03_-Presentaci%C3%B3n_Valle_Itata_FLACMA_Lanzamiento_Campa%C3%B1a_CRk.pdf RIMD. 2012. III Sesión de la Plataforma Regional para la Reducción del Riesgo de Desastres en las Americas http://www.rimd.org/advf/documentos/50a0e77fed9a0.pdf
Resilient Communities through health networks safe from disasters in South America	Pan American Health Organization http://www.paho.org/disasters/index.php?option=com_content&task=view&id=1587&Itemid=1098
Strengthening of the Regional Tsunami Early Warning System: Preparations in Colombia, Chile, Ecuador and Peru	UNESCO. Fortalecimiento del Sistema Regional de Alerta Temprana ante tsunami. Preparativos en Colombia, Chile, Ecuador y Perú http://www .unesco.org/new/es/santiago/education/disaster -risk-managementeducation/strengthening -the-regional-tsunami-early-warning-system/, http://www.unesco.org/new/es/santiago/press -room/newsletters/dipecho -project-newsletter -vii -of-unesco/
Projects combining Ecosystems-based Adaptation or Disaster risk reduction elements	
Isla Mocha Tirúa, a model of sustainable reconstruction for the development of ecotourism	WWF Chile: Isla Mocha-Tirúa, modelo de reconstrucción sustentable para el desarrollo del ecoturismo http://chile.panda.org/?202263/ecoturismoislamochaproye cto;

Source: Cordero et al., (2014).

[19] These four initiatives (2011–2012) were part of the Seventh Action Plan for South America of the Disaster Preparedness Programme (DIPECHO) of the European Commission's Directorate-General for Humanitarian Aid and Civil Protection (see Cordero et al., 2014).

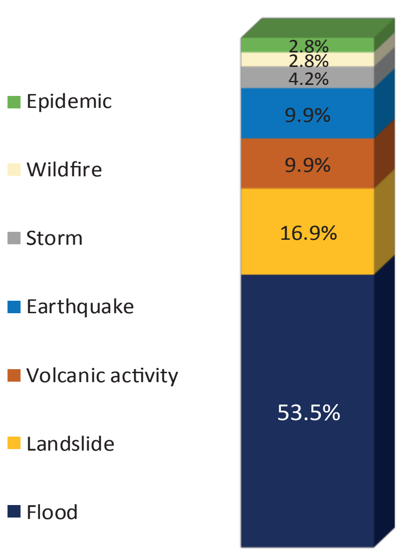
3.4 Case study: Colombia

Key indicators	Unit	in % of region
Land area (km^2)	1,141,750	6.4
Forest area (km^2)[1]	602,970	7.1
Total population	47,791,393	11.5
Rural	11,392,990	23.8
Urban	36,398,403	76.2
GDP(million US$)	377,867	9.1

Period 2000–2015	Unit	in % of region
Registered hazards	71	15.3
Deaths	2,581	21.6
Affected people	10,127,984	13.7
Economic losses ('000 US$)	3,454,000	6.0

Natural hazards

Colombia reported 71 hazardous events during the period 2000–2015, accounting for 15% of the disasters registered in the region; and becoming the second country with the largest occurrence of disasters after Brazil. As seen in Figure 32, floods accounted for 54% of the total occurrence of natural hazards, followed by landslides (17%), volcanic activity (10%) and wildfire (10%). The impacts of these events together resulted in 2,460 deaths and over 10 million people affected.



Disaster type	Total affected	Total deaths
Flood	10,030,832	1,857
Volcanic activity	42,358	16
Epidemic	24,406	91
Earthquake	15,455	14
Storm	10,792	16
Landslide	3,941	556
Wildfire	200	31
Total	10,127,984	2,581

Figure 32. Most common hazards in Colombia, 2000–2015 | *Source: Own elaboration based on EM-DAT (2016)*

During the period 2000–2015, Colombia experienced the highest number of landslides (32%), volcanic activity (30%) and earthquakes (27%) in the region (Figure 33). These three events represented together more than a third of the total occurrence of natural hazards in the country. However, their impact resulted in less than 1% of the population affected by disasters.

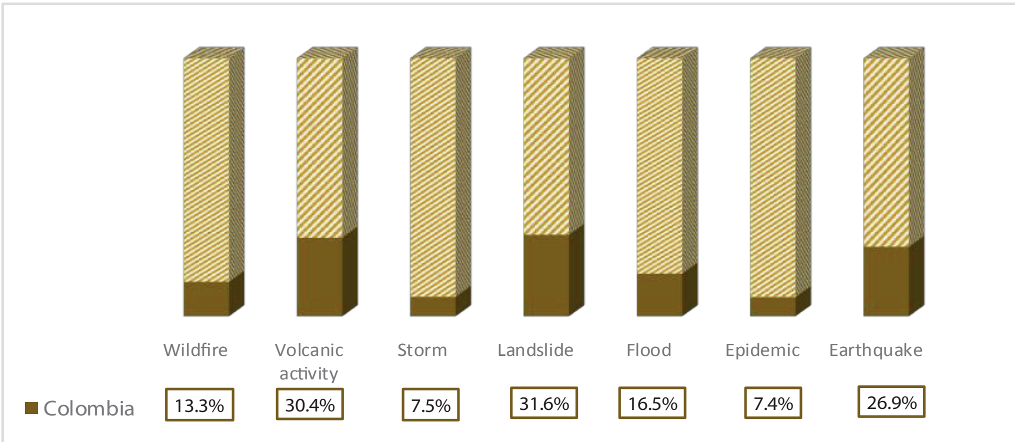


Figure 33. Colombia's proportion of main hazards in the region, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

Floods, on the other hand, accounted for 54% of the natural hazards occurrence; and had the largest impact in terms of deaths and people affected by disasters, as seen in Figure 34. Colombia suffered an average of three floods a year, thus translating into a total of 10 million people affected and 1,857 mortalities. In terms of damages, there is no available information for every year, but the economic losses reach a total of US$ 3 billion, which mostly corresponds to 2010 and 2011.

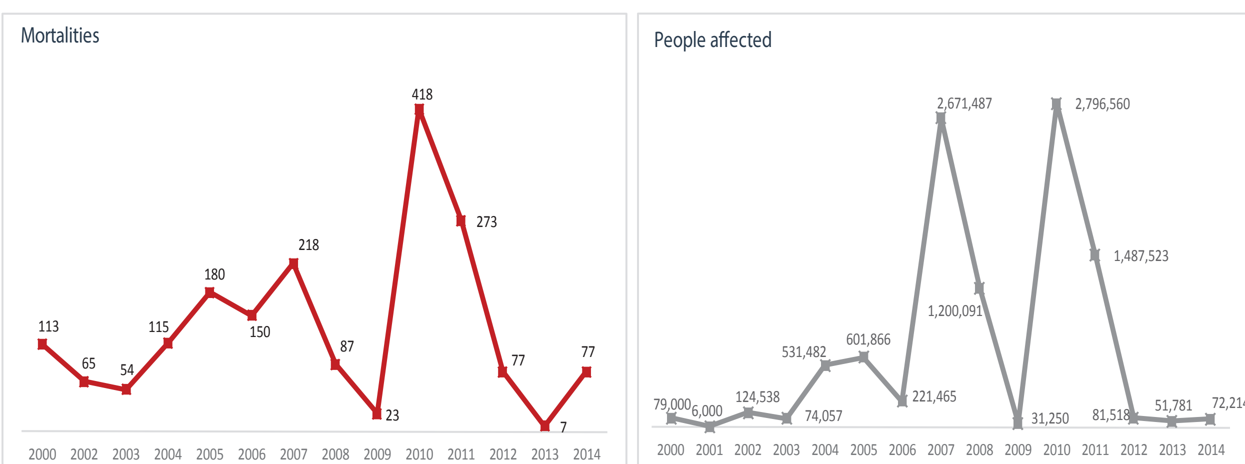


Figure 34. Total deaths and people affected by floods in Colombia, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

Policies and strategies related to Eco-DRR

Biodiversity status, trends and threats

According to the country profile on the CBD, Colombia is listed as one of the world's megadiverse countries, hosting close to 10% of the planet's biodiversity. With **314 types of ecosystems**, Colombia possesses a rich complexity of ecological, climatic, biological and ecosystem components. It is ranked as one of the world's richest countries in aquatic resources, explained in part by the country's **large watersheds** feeding into the four massive sub-continental basins of the Amazon, Orinoco, Caribbean, Magdalena-Cauca and the Pacific. The country has several areas of high biological diversity in the Andean ecosystems, characterised by a significant variety of endemic species, followed by the Amazon rainforests and the humid ecosystems in the Chocó biogeographical area. However, a considerable part of these natural ecosystems has been transformed for agriculture, primarily in the Andean and Caribbean regions. It has been estimated that almost 95% of the country's dry forests have been reduced from their original cover, including close to 70% of typically Andean forests.

The primary terrestrial biomes in Colombia have experienced significant changes; approximately 67% of the national territory is covered by forest (FAO, 2015b). One of the most **threatened forest ecosystems is the dry forest**, with approximately 2% of its original extension. About 2% of the Colombian mainland is covered by **moorlands**, considered one of the most important ecosystems for human well-being because of the **source of water** they provide to more than three-quarters of the population in these areas. The Amazon and Andean regions have the highest number of plant species, followed by the Pacific, the Caribbean region and the Orinoquía.

Colombia's biodiversity is not only important for the country's natural heritage and the preservation of unique species in the world, it is also essential for guaranteeing basic conditions for the improvement of human welfare, social equality and economic development today and in the future. Moreover, biodiversity and its functions and processes provide **direct-use goods and services**, such as food, medicines, fuel, wood and water as well as indirect-use services, such as climate regulation, **prevention of disasters**, soil formation, water purification and recreation.

The main threats to the conservation of biodiversity include, among others: increasing **social inequality**; internal **armed conflict** for more than five decades; returning to a **resource-based economy**; the illegal **drug trade**; **weak access policy and titling**; the use of **extensive livestock and agricultural** models. Such factors contribute to habitat degradation, changes in land use, increased presence of invasive species, climate change, overconsumption of services and general pollution dynamics. There are intrinsic elements that threaten biodiversity protection in Colombia, some of which include a lack of political priority for environmental issues in national and sectoral policies, undesired effects of macroeconomic policies, conflict with indigenous rights and traditional knowledge, and conflicts due to a lack of coordination regarding land-use planning that takes place at various state levels[20].

Fifth National Report

There is no specific mention of DRR or hazards in the Fifth National Report; neither does it specify targets related to DRR. It does, however, refer to sea level rise, drought, food security, erosion, water security and sanitation.

Challenges highlighted in the NR5 that would relate to the implementation of EbA in Colombia include:

- Lack of coordination of entities involved in the EbA, and a lack of political will in decision making.
- Key obstacles include:
  - Mainstreaming biodiversity conservation considerations in the productive sector;
  - Effective solutions to degradation processes, both sectoral and global in nature;
  - Unresolved social and environmental conflicts regarding protected territories;

[20] CBD (n.d). Colombia – Country Profile (https://www.cbd.int/countries/default.shtml?country=co)

- Deficit in economic valuation of biodiversity and cultural values;
- Budgetary resources destined for biodiversity management have been reducing since 1996;
- Fragmentation of responsible institutions for environmental management;
- Insufficient citizen participation mechanisms for environmental management (environmental governance);
- Failure to explicitly recognise the importance of transformed ecosystems;
- Inexistence of sustainability criteria and action plans for fisheries and marine biological resources.

National Biodiversity Strategy and Action Plan (NBSAP)

Colombia has included aspects related to EbA in its NBSAP, which is focused on both people and nature (although EbA is not explicitly included in policies and strategies).

- Protected Areas: Protected Area system extended to exceed 17% of land area, as well as three new national marine protected areas. Management agreements and strategies with active community participation for the valuation and conservation of ecosystem services related to protected areas, and for their sustainable use by local communities.
- Restoration/rehabilitation: The area designated for restoration during 2010–2014 was 68,597 ha, equivalent to 15% of the planned goal. According to the restoration map (1:100.000), a high restoration priority has been designated to 3,700,000 ha, and a very high priority to 1,158,000 ha.
- Additionally, as part of Initiative 20x20, Colombia has committed a total of 1 million hectares for restoration by 2020, this will be achieved through the Ministry of Agriculture.
- Build adaptive capacity, technical capacity, education and awareness: Community Environmental Education Projects (PROCEDA).

National Adaptation Plan

Colombia's experience with promoting EbA and Eco-DRR within the framework of the NAP is described below.

Colombia's National Adaptation Plan to Climate Change has been conceived as a dynamic process that started in 2011. The NAP defines guidelines so that the country's sectors and territories prioritise their actions aimed at reducing vulnerability, and include climate change and climate variability in their planning processes, through the formulation and implementation of territorial and sectoral adaptation plans. These efforts, to date, have focused on the Caribbean and Andean regions, as well as on the transport, housing, energy, agriculture and health sectors, taking into account the damages and losses caused by La Niña phenomena in 2010–2011.

Through national guidelines, the NAP promotes EbA and Eco-DRR approaches by identifying vulnerable socio-ecological systems, concentrating efforts towards analysing impacts of climate change in combination with drivers of transformation and loss of biodiversity and ecosystem services. Additionally, benefits that ecosystem services provide to society are investigated, and options to promote the use of biodiversity and ecosystem services in order to reduce vulnerability of the population in the face of potential disruption that may occur in climate change scenarios. To date, Colombian entities have formulated 11 territorial adaptation plans to climate change, which have prioritised adaptation actions. These plans are the basis for decision-makers to identify the vulnerability of the territory and define adaptation measures to be incorporated in the different development and spatial planning instruments.

EbA and the Eco-DRR measures that are currently being implemented in the NAP include:

- The rehabilitation of wetlands and their hydrology as a means to reduce risk of flooding and drought associated with climate change and variability.

- The identification and implementation of adaptation measures designed to mitigate the impacts of climate change on the water yield and hydrological regulation capacity of the wetlands and high mountain ecosystem.

The NAP also identifies key entry points for the application of EbA and the Eco-DRR approaches regarding water supply, specifically:

- Moors (*páramo*, Andean woodlands), wetlands, high Andean forests, cloud forests and tropical forests
- Ability of soils and microclimates setting for growing crop
- Moderation of extreme events through buffer structures
- Prevention of erosion and sediment control.

The Government of Colombia participated in the CBD Technical Workshop on EbA and Eco-DRR (SCBD, 2016). Additionally, Colombia implemented an Integrated National Adaptation Plan (INAP)[21] to address climate change threats. In line with the promotion of EbA approaches and policy interventions to address climate change impacts, with particular emphasis on high mountain ecosystems in the country. Further detail on the INAP is provided in the next section outlining Eco-DRR Initiatives in Colombia.

Protected Areas

Colombia's Climate Change Adaptation Framework for Marine Protected Areas addresses the need for developing a framework methodology integrating i) technical actions to assess climate risks and resilience of the protected area's conservation targets, ii) prioritisation of climate adaptation actions, iii) implementation of priority actions to increase resilience and adaptation capacity; and iv) integrating adaptation measures with the park's existing planning tools in Gorgona National Park.

The project provides a framework that allows protected area managers in Colombia to mainstream the necessary actions to increase the resilience of coastal and marine ecosystems within the existing planning framework, strengthening the protected areas capacity to provide environmental goods and services, and to benefit conservation objectives and communities in the face of existing and future climate conditions.

<u>Ecological benefits:</u> Gorgona National Park aims to maintain ecological integrity of its conservation targets, particularly **coral reefs and the pelagic ecosystem**. To that end, the protected area periodically (every 4–5 years) assesses ecological integrity of its conservation targets and monitors climate adaptation benefits.

<u>Social benefits:</u> It allows the local fisheries to coordinate their activities to protect a common resource. It also increases information and knowledge about the benefits of the protected area.

<u>Economic benefits:</u> An increase in fish stocks is expected. Continual monitoring is carried out to report accurate results.

[21] INIAP was a GEF funded project, which was implemented until 2011, with support from the World Bank.

Box 7. EbA approaches and policy interventions – Colombia

Colombia is implementing its Integrated National Adaptation Plan (INAP) to address climate change threats. In line with the promotion of EbA approaches and policy interventions to address climate change impacts, the Institute of Hydrology, Meteorology and Environmental Studies (IDEAM) supports the development of INAP, which focused on high mountain ecosystems (glaciers, high Andean forests and *páramos*).

In this area, a number of EbA measures are being implemented, which includes the identification and implementation of ecosystem management actions that can increase ecosystem resilience and reduce vulnerability of both farming systems and local human communities. Projects are embedded into national, regional and local policy-making efforts and spatial planning.

In the high mountain ecosystems in the Colombian Andes, the Chingaza Massif Climate Change Assessment for Planning, Management and Maintenance of Ecosystem Services, including Hydropower Potential, is being carried out in coordination with IDEAM, Conservation International (CI), Institute of Marine and Coastal Research (INVEMAR), Corporation for the Sustainable Development of the San Andres, Providencia and Santa Catalina Archipelago (CORALINA), and the National Institute of Health (INS).

IDEAM generated knowledge of ecological and climate processes at national level, as well as at local scales such as in the Chingaza Massif. During this exercise, two nationwide scenarios were assessed, following parameters established by the IPCC: the A2 "Pessimistic" scenario, and the B2 "Optimistic" scenario. Results from both the optimistic and pessimistic scenario revealed a tendency to more intense droughts in High Mountain and *Páramo* ecosystems, with a projected 10% to 30% increase regarding the driest periods in comparison to the present situation. This would imply an increase in dry and drought-stricken area of more than 4 million hectares for the period 2071–2100; a concerning prospect in terms of livelihoods, and community and ecosystem resilience.

Source: IDEAM (2016)

Fundación Humedales, with the *Corporación Autónoma Regional de los Valles del Sinú and San Jorge-CVS*, coordinated the development of the management plan for the *Arroyo Carolina* micro-watershed, located in the Planeta Rica, San Carlos and Pueblo Nuevo Municipalities, and is of particular importance for the area because:

- It is the primary water source for the Planeta Rica aqueduct, which provides water to the large farms in the region that work mostly in cattle raising, commercial forestry plantations, and oil palm production, as well as smallholder farmers from the upper watershed.
- It receives wastewater discharge from the Planeta Rica urban centre.
- It is a seasonal watershed, with its rivers and streams fed by runoff and direct rainfall in winter, but it is dried up in summer months.

The micro-watershed includes tropical dry forest, gallery forest, and the aforementioned agricultural lands in the Department of Córdoba. This work enabled the different uses of the watershed to be identified and mapped, with an associated vulnerability analysis and management plan oriented towards CCA.

Key hazards identified for the watershed include: floods, torrential rain, landslides, contamination of water supply, and different combinations of these. These risk factors were overlapped with the land-use zoning for the watershed, which allowed high risk areas to be identified and mapped. The management plan detailed relevant mitigation measures designed for each land-use type and risk; these Eco-DRR measures were associated specifically with the restoration and recovery of ecosystems present in the watershed.

In relation to the role of Andean wetlands in response to climate change, ***Fundación Humedales*** developed a vulnerability assessment and adaptation strategy for a wetland complex in the highlands on the Eastern Cordillera of the Colombian Andes –*Lagunas de Fúquene, Cucunubá and Palacio*– located in the Altiplano Cundiboyacense, between the departments of Cundinamarca and Boyacá. This involved fieldwork, historical climate and hydrological data, land cover maps, workshops and interviews with local and regional stakeholders relevant for the management and use of ecosystem services derived from the lagoons in the *Valle del Río Ubaté*.

The Department for Western Andes Territory ––from the **Department of National Parks**––implement an ongoing zone management system in the high mountain landscapes of the Western Andes in Colombia. Implicit to this work, is the definition of activities relevant for the risks identified for each zone; which include restoration, population management and regulation of access.

Payment for Ecosystem Services (PES) schemes to compensate protected areas, communities, indigenous peoples and private landowners for maintaining forests and other water regulating habitats are being piloted for water services in Colombia (Lopoukhine *et al*., 2012)

<u>WWF</u>
As part of its initiative for reducing risk in river basins prone to flooding, WWF developed “Reducing the Risk of Floods: A Good Practices Guide for Natural Resource Based Practices”. This guide includes capacity building material on DRR, based on **integrated management of ecosystems and green infrastructure**.

<u>Alexander von Humboldt Research Institute of Biological Resources</u>
The Alexander von Humboldt Research Institute, along with public companies from Medellin and the Autonomous Corporation of Antioquia, is currently implementing a project to restore highly degraded dry forests in the Ituango Municipality, Department of Antioquia. The restoration activities are envisioned to compensate environmental harm caused by the construction of a reservoir, and to contribute to the conservation of the fragile dry forest ecosystem of the area. Three pilot projects will restore 17,000 ha

of forest landscape, which serves as a reference for compensation.

Forest landscape restoration (FLR) is a process that aims to regain ecological integrity and enhance human well-being in deforested and degraded forest landscapes. It involves people coming together to restore the function and productivity of degraded forest lands – through a variety of place-based interventions, including new tree plantings, managed natural regeneration, or improved land management.

FLR relies on active stakeholder engagement in the process and can accommodate a mosaic of different land uses, including agriculture, agroforestry, protected wildlife reserves, regenerated forests, managed plantations, and riverside plantings to protect waterways[22].

The Alexander von Humboldt Research Institute also implemented a project prioritising Andean ecosystems for restoration in the Antioquia region. This entailed identifying priority sites for restoration based on degradation and risks, leading to the development of geospatial data to assist in decision making.

The *Corporación Ambiental La Pedregoza*, in partnership with the Alexander von Humboldt Research Institute, set out to improve certain land-use practices with the introduction of silviculture in the *Río Bita* basin. The basin is located in Vichada Department, and covers moriche palm swamps, gallery forest and flooded forests.

The project, CO2 Tropical Trees, is based on a compensation scheme focusing on tree planting for carbon sequestration, covering natural forest and savannah ecosystems.

[22] IUCN (n.d.) Forest Landscape Restoration: https://www.iucn.org/about/work/programmes/forest/fp_our_work/fp_our_work_thematic/fp_our_work_flr/

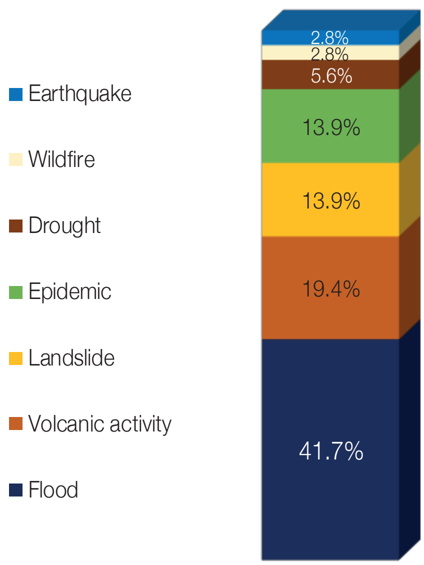
3.5 Case study: Ecuador

Key indicators	Unit	in % of region
Land area (km^2)	256,370	1.4
Forest area (km^2)[1]	94,698	1.1
Total population	15,902,916	3.8
Rural	5,802,020	36.5
Urban	10,100,896	63.5
GDP (million US$)	100,543	2.4

Period 2000–2015	Unit	in % of region
Registered hazards	36	7.7
Deaths	349	2.9
Affected people	1,264,484	1.7
Economic losses (´000 US$)	1,181,475	2.1

Natural hazards

Ecuador reported 36 hazardous events during the period 2000–2015, accounting for 8% of the disasters registered in the region. As seen in Figure 35, floods accounted for 42% of the total occurrence of natural hazards, followed by volcanic activity (19%), landslides (14%) and epidemics (14%). The impacts of these events together resulted in 341 deaths and 1.2 million people affected.



Disaster type	Total affected	Total deaths
Flood	539,851	238
Volcanic activity	500,183	5
Epidemic	111,287	23
Drought	110,665	-
Wildfire	1,945	5
Landslide	535	75
Earthquake	18	3
Total	1,264,484	349

Figure 35. Most common hazards in Ecuador, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

With over half million people affected, floods and volcano related events became the most significant disasters reported by Ecuador during the period 2000–2015 (Figure 36). Floods were also the first cause of mortalities, accounting for 68% of the deaths caused by disasters in the country.

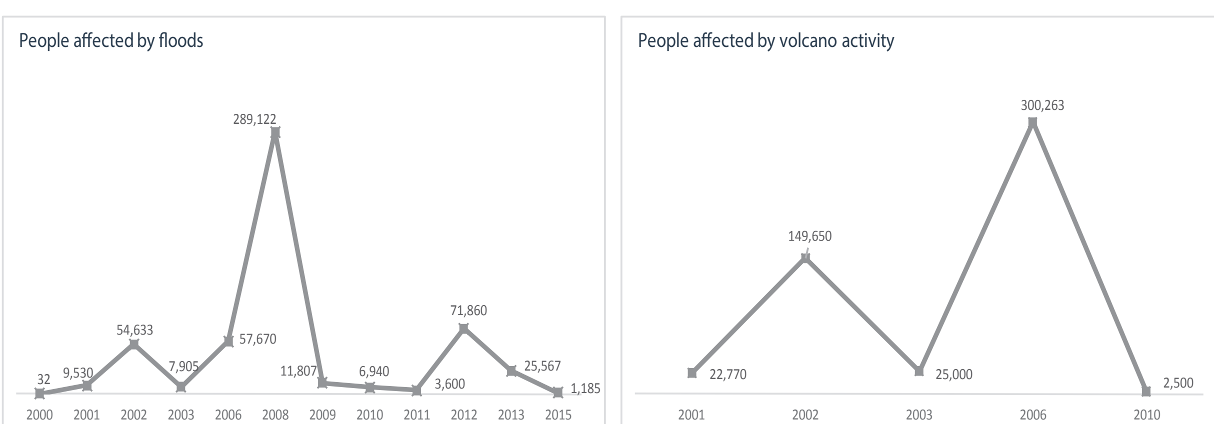


Figure 36. People affected by floods and volcano activity in Ecuador, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

Ecuador represented with Colombia the highest occurrence of volcano activity in South America. According to the data shown in Figure 37, the country also accounted for 19% of epidemics and 13% of landslides in the region. The impact of these two events resulted in almost a third of mortalities in the country.

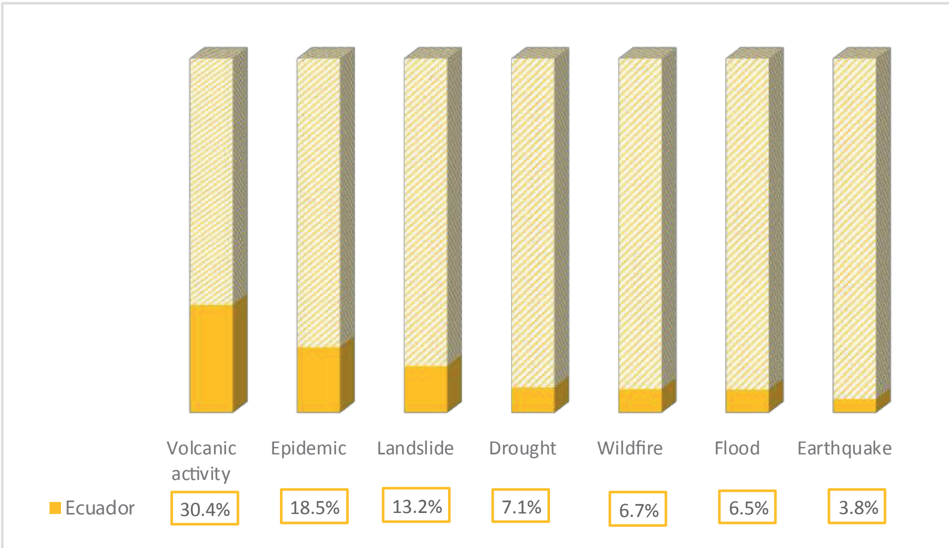


Figure 37. Ecuador's proportion of main hazards in the region, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

Policies and strategies related to Eco-DRR

Biodiversity status, trends and threats

According to the country profile on the CBD, Ecuador is one of the 17 megadiverse countries of the world. This diversity is due to the location of the country in the neotropics, the presence of the Andes and the influence of the ocean currents on its coasts. It is divided into four well-defined natural geographical zones: coast, mountain range, the Amazon and the Galapagos Islands. In terms of conservation, it is divided into continental Ecuador and the Galapagos Islands, although such efforts are not homogeneously divided in the country. Ecuador possesses 26 distinct habitat types, each one with characteristic flora related to altitude and precipitation levels. Among them are three of the world's 10 biodiversity hotspots, namely, the humid forests of the northwest, outside faces of the mountain range and the Amazon forests of the northeast.

Ecuador is recognised globally for its vast floristic richness, which is still not very well known and often threatened. It is estimated that the country has more plant species per unit area than any other country in South America. However, the Galapagos National Park and the Marine Reserve, declared UNESCO World Heritage Sites, are presently in danger. In response, the government has undertaken a series of actions aimed at strengthening the institutional processes in the region.

The total forest cover is about 11.6 million ha, of which 11.5 million ha constitute natural forest and 78,000 ha plantations, representing 42% of the total national surface area. Ecuador has red-listed vertebrates, birds and reptiles. Although a IUCN Red List of Threatened Species does not exist for Ecuador's amphibians, their conservation status has been categorised by the Global Amphibian Assessment (GAA, 2004), which has been an effective tool for taking management and conservation decisions.

No documentation exists to clarify the conservation status of fish species. Ecuador recognises that in spite of the fact that information on biodiversity has increased in the last few years, information is still lacking in regard to the country's ecosystems and drivers of change to biodiversity.

The Galapagos Islands are unique in the world in that they are a self-contained ecological system and an ecoregion with a high level of biological endemism. These islands constitute the last undisturbed ecosystem of insects in the world where it is possible to identify patterns that existed before homogenisation by introduced species of insects. Notably, it is estimated that 50% of vertebrates could become extinct if conservation efforts are not successful. Bird species appear to have a greater potential risk of extinction. In the last few years, there has been no evidence of biodiversity loss. To this day, 95% of the original biodiversity has been maintained. The Galapagos could represent one of the largest conservation challenges and opportunities for Ecuador.

The main threat to biodiversity conservation in Ecuador is deforestation, with the country ranked second among Latin American countries in terms of highest levels of deforestation. Firewood collection, urban expansion, petroleum exploration and exploitation, agriculture, mining, fishing, overexploitation of natural resources, poverty, human migrations, tourism development, and introduced species are other important aspects contributing to the deterioration of the country's biological richness in both continental and island areas.

Biodiversity has been integrated in the following sectors: agriculture, education, health, fisheries, water resources, mining and petroleum, tourism and commerce/industry.

Continental Ecuador does not possess any plans or legislation on land use. Conversely, the Galapagos Islands have strong spatial plans. In the last 10 years, legislation regarding the development of the islands has been put in place, restricting residents' freedom of rights, ownership and commercial activity. Spatial plans in the Galapagos include a regional plan to regulate land management, the Galapagos National Park Management Plan and the Galapagos Marine Reserve Management Plan.

The National Development Plan highlights a number of protection and recovery initiatives related to forests (e.g. National Decentralised Forest Control System, Reforestation and Conservation Programme for the Chongón-Colonche Mountain Range, Green Watch Program, National Forestry Program, National Plan for Afforestation and Reforestation, strengthening of an outsourced system for forest control).

Fifth National Report

Although there are no specific DRR targets in Ecuador's Fifth National Report, it does mention DRR. Also, highlighting the following natural hazards, and their importance in the country: flood/storm surge, sea level rise, drought, food security, fire, erosion and sanitation.

Challenges highlighted in the NR5 related to the implementation of EbA in Ecuador include:

- Transboundary cooperation to implement Conservation Corridor and Sustainable Development projects, serving as management models, and to reduce existing conservation pressures and threats, to improve protected area management and contribute to social cohesion and border integration in the Putumayo region.
- A serious challenge is to reduce the expansion of the agricultural frontier, illegal logging, defaunation, natural system disruption, and negative impacts of development projects, especially hydrocarbon, hydroelectric, mining, infrastructure in natural forest areas and páramos.
- Data reveals deterioration in terms of quantity and quality of forest cover and natural ecosystems, and an increase in the number of endangered and threatened species. Ecosystem goods and services are subsequently experiencing significant disturbances, and with these, affecting the national and local population.

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[23] CBD (n.d). Ecuador – Country Profile (https://www.cbd.int/countries/default.shtml?country=ec)

National Biodiversity Strategy and Action Plan (NBSAP)

The National Biodiversity Policy and Strategy (*Política y Estrategia Nacional de Biodiversidad del Ecuador 2001–2010*) addresses five main themes: fragile ecosystems (with a particular emphasis on páramo, wetlands, mangroves, marine ecosystems and dry forest), strengthening of the protected areas national system and protection of threatened species, sustainable agriculture and the rehabilitation of degraded areas (emphasising food security and sovereignty), biocommerce, biosafety and genetic resources.

The document proposes 4 main strategic axes, as well as management measures, areas of priority and actions: (1) consolidate and strengthen the sustainability of production activities based on native biodiversity; (2) ensure the existence, integrity and functionality of all biodiversity components (ecosystems, species, genes); (3) balance pressures from conservation and sustainable use on biodiversity; and (4) guarantee the respect and exercise of individual and collective rights to participate in decisions related to access and control of resources, and ensure that the benefits derived from the conservation and sustainable use of biodiversity, as well as from the use of knowledge, innovations and practices of the indigenous communities and local populations, are justly and equitably distributed. It is recognised that, in spite of the existence of Environmental Impact Assessment legislation, the State has often failed to comply with the constitutional mandate to consult affected populations. Other sectors that have also not complied with this mandate are agribusiness, mining, manufacturing, timber and fisheries.

To date, the NBSAP has not been properly implemented due to its many limitations (e.g. the scope of competencies of different government levels is unclear, mainstreaming strategies are limited). Also, the legal framework for the NBSAP is incomplete and one of the main obstacles to its implementation. Moreover, initiatives in Ecuador are not necessarily linked to the NBSAP, which was created in 2000 and only approved in 2007. Consequently, initiatives have followed a "common sense" approach and considered the experiences gained by different private, public and international organisations.

Ecuador is currently in the process of updating its NBSAP. And the implementation of the **CBD 2011–2020 Strategic Plan** in Ecuador is ongoing.

Ecuador includes EbA related aspects in its NR5 / NBSAP, with a particular focus on nature.

- Assess impacts, risk or vulnerability of people from climate change impacts, evaluate scenarios: the project Climate Change Adaptation with Effective Water Governance in Ecuador (PACC) has contributed with decision-making tools, such as the application of climate change scenarios, vulnerability studies, capacity strengthening and formation of national and local stakeholders related to the management of water resources, agriculture, hydroelectricity, and the provision of water for human consumption.
- Protected Areas:
  - 5,014,993 ha correspond to 19.6% terrestrial and 13,500,000 ha marine protected areas.
  - National System of Protected Areas (SNAP) is currently composed of 51 areas (divided into eight protected area management categories).
- Restoration/rehabilitation: As part of the national policy on the Governance of Natural Heritage, in 2011 the process began for ecological restoration of degraded areas in ecosystems considered key for development in the country; in the period 2011–2013, approximately 42,000 ha were restored.
- Additionally, as part of Initiative 20x20, Ecuador has committed a total of 500,000 hectares for restoration by 2020, this will be achieved through the Ministry of Environment.

- Build adaptive capacity, technical capacity, education and awareness: To strengthen capacities of protected area officials, the Ministry of Environment, along with EcoFondo Foundation and the Centre of Education and Promotion (CEPP), established the Green Classroom Programme. Through vocational training, this Programme constitutes a national effort to improve SNAP and wildlife management in the country.
- Manage threats to biodiversity, e.g. invasive species (AIS): Of the 44 introduced alien species, five species have been identified for their greater incidence and impact for the agricultural sector, as well as ecosystems and even on human health in Ecuador. Competent state institutions operate management plans for the monitoring and eradication of these species.
- REDD+: Since 2009, Ecuador has been participating, and advancing in preparations for REDD+, generating institutional arrangements and information gathering from the forest sector to ensure adequate policy, technical, legal and institutional capacities necessary for REDD+ implementation.

Aichi Biodiversity Targets

The government has taken several important steps in the **Galápagos** Islands to support the conservation of biodiversity (e.g. conversion of 96% of land area into a national park, commitment to protect the Galapagos as a World Heritage Site and Biosphere Reserve, creation of the Marine Reserve of the Galapagos).

As a result of various initiatives, such as the **Reforestation and Conservation Programme for the Chongón-Colonche Mountain Range**, the rate of deforestation has been reduced from 2.39% (1990–2000) to less than 0.5% (2005) annually. In the last 10 years, the **clearing of mangroves has also been reduced**. Conservation advances in the Galapagos Islands correspond to **the recovery of threatened species** (e.g. giant turtles, iguanas, red-footed booby, mangrove finch), as well as to **the recovery of important ecosystems**. Studies have been conducted on turtles and the pink iguana, as have censuses on native and endemic bird populations.

The Ministry of Environment has developed and promoted initiatives **to train and educate forest rangers** in Ecuador. A **Marine Coastal Environmental Education Programme** also exists which aims to raise biodiversity awareness among populations living in coastal zones and on riverbanks. Public awareness programmes require strengthening as current resources are insufficient to influence public opinion. Numerous activities have emerged from local initiatives and are linked to issues such as forest resources management, alternatives to reduce marginalisation and poverty, definition of the uses of biodiversity products and environmental services, among others.

The three objectives of another initiative entitled the "Socio Bosque" (Forest Partnership) Programme[24] include: the protection of forests and their economic, ecological and cultural values; the reduction of deforestation rates and forest degradation and associated GHG; the improvement of the living conditions of the poor through sustainable forest management. However, due to limited resources, there are no programmes to control invasive species in continental Ecuador. However, an inspection and quarantine system exists in the Galapagos to prevent the introduction of new species and organisms to the region.

A project focused on capacity building for socioeconomic assessment of the High Andean wetlands is underway. Activities include training and awareness raising for environmental decision-makers, municipal technicians, water authorities and other groups on the values and functions of local wetlands through socioeconomic assessments. Efforts are concentrated on two regions in particular (Tungurahua and Ona-Saraguro-Yacuambi). Training modules for socioeconomic valuation have been developed.

[24] http://sociobosque.ambiente.gob.ec/

National Adaptation Plan

The Ministry of Environment is responsible for implementing the National Climate Change Plan, designed to facilitate the coordination of short-term actions, promoting the mainstreaming of climate change in institutions, sectors, and in territory, with effective participation of local communities. Whilst the ecosystems sector promotes actions to improve the resilience of natural heritage in the country.

Additionally, in Ecuador, an assessment of vulnerabilities and impacts was conducted as part of a project on water governance, utilising diverse tools such as climate change scenarios, models, and vulnerability studies, which were used to increase capacity to manage water and agricultural resources (reported in Ecuador's fifth national report).

National Disaster Management Plans

Ecuador includes disaster risk management in the Constitution and national development plan. The country's Secretariat for Risk Management received support from UNDP in the project to strengthen institutional and community capacity at national and local levels, to reduce vulnerability to seismic events in Ecuador. However, this project is focused more on contributing to the process of the New Ecuadorian Construction Code.

The assessment of vulnerabilities and impacts was conducted as part of a project on water governance, utilising diverse tools such as climate change scenarios, models, and vulnerability studies, which were used to increase capacity to manage water and agricultural resources (reported in Ecuador's fifth national report).

Eco-DRR Initiatives

Direct comparisons between the costs of investing in built infrastructure and maintaining natural habitats as protected areas are scarce, but **some countries are already investing in habitat protection or restoration as part of DRR strategies**.

Box 8. Critical Forests and Wetlands to Combat Flooding – Ecuador

In Ecuador, flood control projects use the natural storage and recharge properties of critical forests and wetlands by integrating them into "living with floods" strategies that incorporate forest protected areas and riparian corridors.

Such protection forests also form part of DRR strategies in the country, and will serve to protect infrastructure from frequent disasters including rock fall, avalanches or landslides.

Source: Quintero (2007)

The Climate Change Adaptation through an effective water governance project (PACC) had the objective to reduce climate change vulnerability in Ecuador, through the efficient use of water resources. The project has supported the development of the National Climate Change Strategy and the National Climate Change Plan. In addition to 36 community-level projects focused on agroecology and forests, with the recovery of ancient knowledge and practices to ensure sufficient water resources now and in the future.

Box 9. Inclusive and sustainable watershed management for CCA - Ecuador

The ***Corporación Grupo Randi Randi*** (CGRR) has been implementing a project in the Andean *páramos* and forest. The project focuses on CCA and incorporates local concerns related to environment, livelihoods and disaster risk in the *El Ángel* watershed, Ecological Reserve *El Ángel* region, in the northern Andes of Ecuador.

To promote sustainable livelihoods and reduce the threat of natural disasters such as floods and drought, CGRR is using a coordinated and participatory approach, involving communities, public sector, and civil society and non-governmental organisations to support food security and build resilience to disasters and climate change.

The project works to sustainably and equitably manage water and land resources through the promotion of dialogue, actions and collaboration between small producers, rural families and irrigation consortia with public institutions in the mid- and lower- watershed. Key to improving water resource governance, and therefore to the success of the project, is the role of existing multi-stakeholder spaces, such as the **Steering Committee for the Ecological Reserve El Ángel**. The Committee enables dialogue among water users in the catchment area (community organisations, local community and local government) to support the inclusive management of water resources in an equitable and sustainable manner. Equally, strengthening community structures to discuss natural resource use and access, and the creation of agreements and mutually beneficial incentives for all water users in the basin.

A contribution towards reducing vulnerability and strengthening resilience to climate change is achieved through adaptation measures and conservation of ecosystem services in the watershed. Implementation of activities incorporated into land-use management plans to protect riverbanks and wetlands in territories within the Ecological Reserve *El Ángel*. In addition to a study to assess the impact of climate change on principal crops in the lower/medium *El Ángel* watershed. A climate change vulnerability assessment was carried out in a key irrigation area in Pueblo Viejo, and capacities strengthened for members of the irrigation consortia.

A participatory process permitted the definition and inclusion of relevant climate change considerations in local government development and land-use zoning plans in the *El Ángel* watershed, including La Libertad and San Isidro. And in collaboration with the University of San Francisco of Quito, a pilot system was implemented for participatory monitoring of water quality and quantity in the micro-watershed Río Mal Paso-Colorado of the *El Ángel* watershed.

Eco-DRR can be integrated into watershed development planning. Upstream and downstream river users are brought together to tackle disaster risk and development planning in a more integrated manner.

Source: CGRR (2016)

In Ecuador, about 80% of Quito's more than 1.5 million residents receive drinking water from two protected areas in the Andes, the Cayambe – Coca (400,000 ha) and Antisana Ecological Reserves (120,000 ha). Payments for ecosystem services (PES) schemes to compensate protected areas, communities, indigenous peoples and private landowners for maintaining forests and other water regulating habitats are being piloted for water services in Ecuador (Lopoukhine et al., 2012).

Restoring natural grazing patterns: research in the Chimborazo Faunal Production Reserve has shown the ecological benefits of encouraging the husbandry of native camelids, instead of cattle and horses. Benefits include a higher stocking rate with llamas and improved pasture conditions. New protected areas and mosaics of land use are being designed to establish ecological corridors in the Vilcabamba-Amboró region, a 30 million ha expanse of the Andes in Colombia, Venezuela, Ecuador and Peru (Lopoukhine *et al*., 2012).

Box 10. Addressing Food Security: traditional knowledge for adapting productive systems to climate change - Ecuador

Ecopar implemented a project to strengthen capacities of local stakeholders for the planning and application of CCA measures in the páramos of Chimborazo. The project implemented and promoted sustainable land-use practices in the *páramos* to reduce climate change vulnerability. This was achieved, in part, through the promotion of policies and strategies that contribute to the conservation and management of *páramos*, based on ecosystem-based management with an emphasis on local nature-based solutions to CCA.

The project also supported the development of sustainable livestock production in Chorrera Mirador and *Pulinguí San Pablo*, which included: pastures improvements and the incorporation of windbreaks to reduce vulnerability of pastures to frost and strong winds prevalent in the area. Regarding agriculture and food security, composting pens and organic fertilisers were used to reduce soil degradation. Agroecological or conservation agriculture practices, in addition to improving food security, build on the natural resources smallholder farmers already have, using both local and scientific knowledge. Therefore, promoting actions to improve the productivity and livelihoods of smallholder farmers is crucial to achieving the poverty and food security goals of the Sustainable Development Goals (SDGs).

Management and conservation of the páramos and water resource was implemented by protecting upper-catchment slopes, cultivating grazing areas with native species of trees and shrubs for windbreaks. With the reintroduction of an ancestral technique for water management, the irrigation of alpaca grazing areas was improved. Improvements were made to local water harvesting systems, resulting in increased water availability for irrigation. Restoration of water courses and vulnerable areas to climate impacts was realised with native tree species. Canals were constructed as an alternative for water supplies and fulfilling the regions irrigation needs. Restoration of degraded wetlands, a key source of water for the communities and their livelihoods was also achieved.

These conservation strategies play an important role in preserving the fragile *páramo* ecosystem, and the agricultural and ecological systems on which the livelihoods of local communities depend. Fundamentally, they also contribute to CCA and DRR for both agroecosystems and households.

Source: Ecopar (2016)

3.6 Case study: Peru

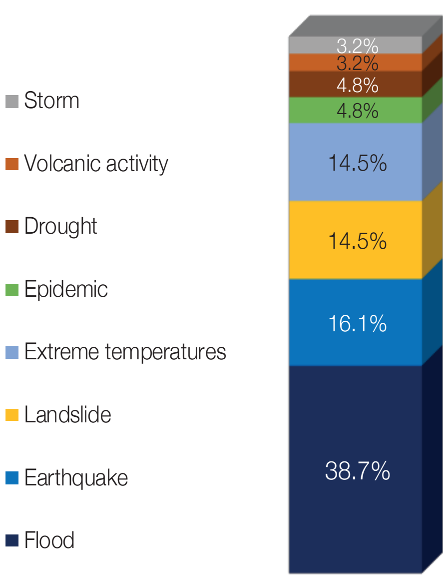
Key indicators	Unit	in % of region
Land area (km^2)	1,285,220	7.3
Forest area (km^2)[1]	676,920	8.0
Total population	30,973,148	7.5
Rural	6,725,819	21.7
Urban	24,247,329	78.3
GDP (million US$)	202,642	4.9

Period 2000-2015	Unit	in % of region
Registered hazards	62	13.3
Deaths	3,589	30.0
Affected people	8,582,249	11.6
Economic losses ('000 US$)	900,050	1.6

Source: own elaboration based on WDI (key indicators) and EM-DAT (natural hazards), 2016
Note: [1] Last data available from 2012

Natural hazards

Peru reported 62 hazardous events during the period 2000–2015, accounting for 13% of the disasters registered in the region. As seen in Figure 38, floods accounted for 39% of the total occurrence of natural hazards, followed by earthquakes (16%), landslides (15%) and extreme temperatures (15%). The impacts of these events together resulted in 3,490 deaths and 8.4 million people affected.



Disaster type	Total affected	Total deaths
Extreme temperatures	5,189,300	1,957
Flood	2,182,434	498
Earthquake	1,029,738	758
Storm	86,682	75
Epidemic	65,960	24
Drought	21,500	-
Volcanic activity	4,040	-
Landslide	2,595	277
Total	8,582,249	3,589

Figure 38. Most common hazards in Peru, 2000–2015 | *Source: Own elaboration based on EM-DAT (2016)*

Floods and earthquakes accounted for over a third of the population affected by natural hazards in the country during the period 2000–2015. While floods were reported almost every year, the worst impact resulting from earthquakes was registered in 2001 and 2007. According to the data, floods affected a total of 2 million people and caused 498 deaths; there is no information about economic losses. The impact of two earthquakes, on the other hand, resulted in 1 million of the population affected, represented US$ 1 million in damages and were responsible for 21% of the total mortalities caused by disasters in the country (Figure 39).

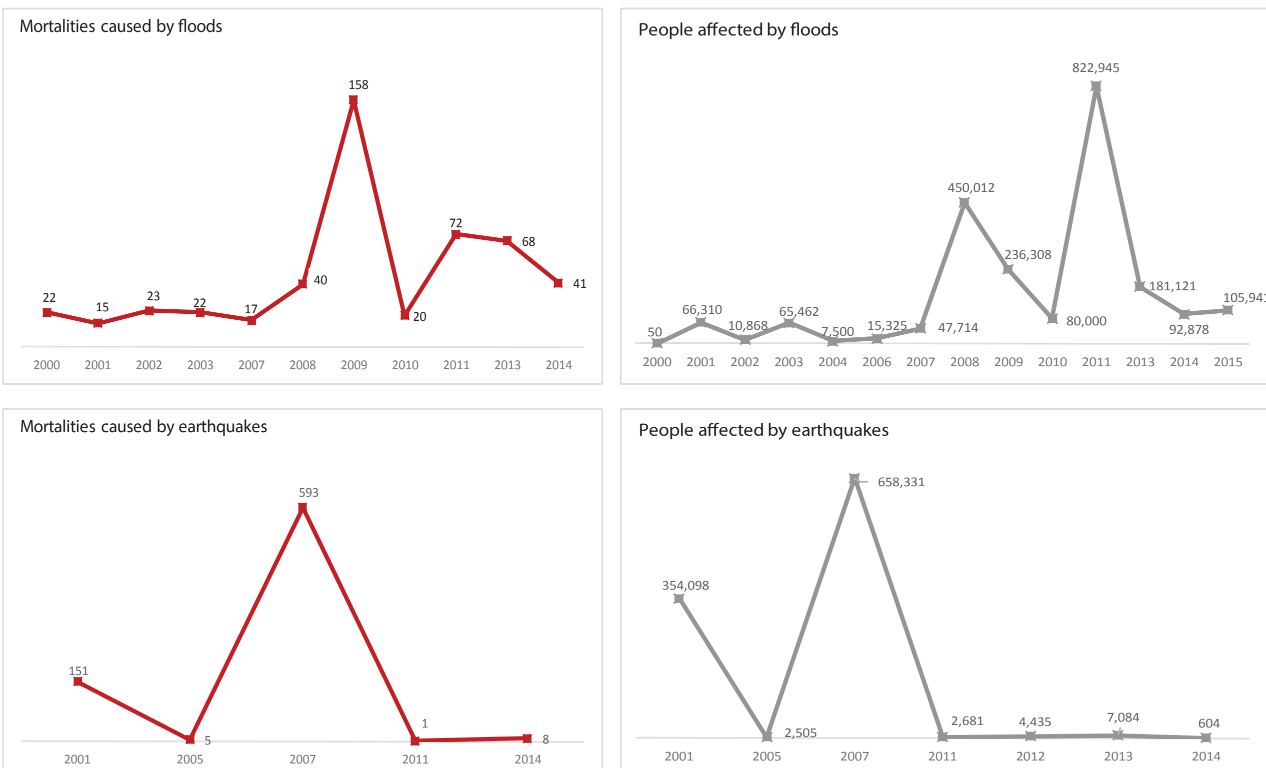


Figure 39. Total deaths and people affected by floods and earthquakes in Peru, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

Peru reported the highest occurrence of extreme temperatures in South America, accounting for 24% of these events in the region (Figure 40). Extreme temperatures had the most significant impact in terms of deaths and people affected by natural hazards in the country. These events resulted in 55% of the mortalities associated with disasters in the country, and reached a total of 5 million people affected during the period 2000–2015. However, it is important to point out that their impact has decreased substantially, from 2 million people affected in 2004 to 100,000 people affected in 2014. There is no available information about economic losses related to these events.

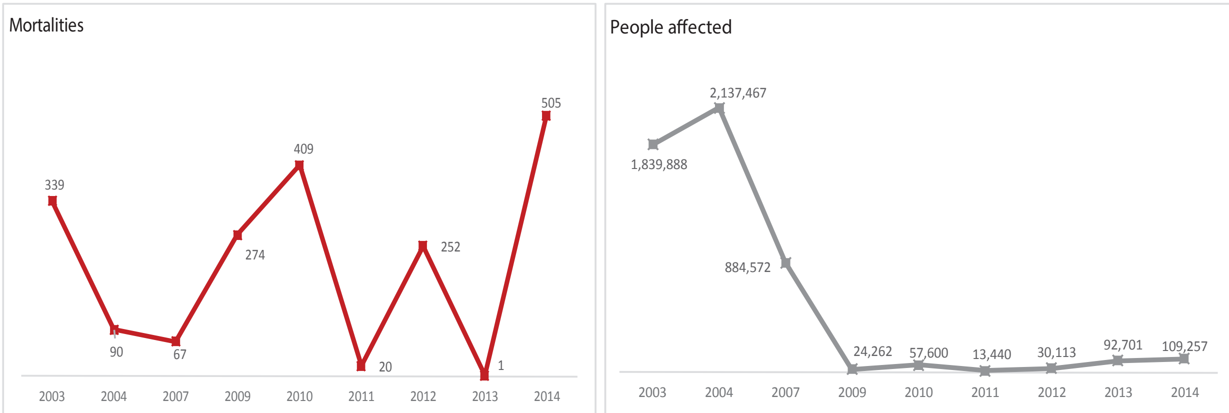


Figure 40. Total deaths and people affected by extreme temperatures in Peru, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

Peru reported the largest occurrence of most of the natural hazards reported in the region. As seen in Figure 41, the country accounted for 39% of earthquakes, 24% of landslides, 24% of extreme temperatures, 11% of epidemics, 11% of droughts, 10% of floods, 9% of volcanic activity and 5% of storms.

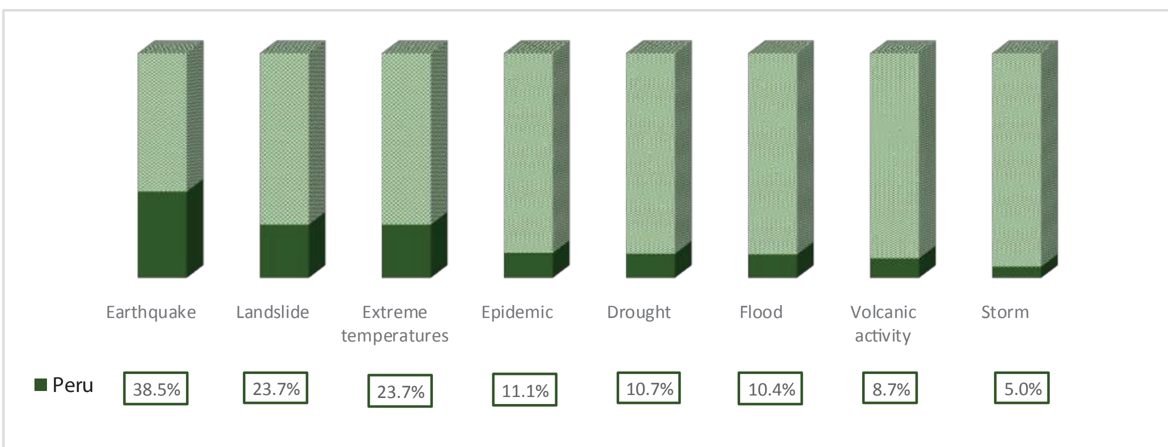


Figure 41. Peru's proportion of main hazards in the region, 2000–2015
Source: Own elaboration based on EM-DAT (2016)

Policies and strategies related to Eco-DRR

Biodiversity status, trends and threats

According to the country profile on the CBD, owing to its rich diversity in ecosystems, species, genetic resources and culture, Peru is one of the world's megadiverse countries. Its biodiversity is one of the pillars of the national economy, playing a direct role in sustaining a large part of the population, and playing an important role for culture, science and technology, providing essential environmental services in terms of soil fertility, air quality and water supply.

In Peru, approximately 65% of the national territory is covered by forest (FAO, 2015b). The country hosts about 25,000 plant species, with 30% endemism. Of these, 4,400 species have known properties and are used by the population. In terms of fauna, it has close to 2,000 fish species; 1,736 bird fauna species; 332 amphibian species; 460 mammals and 365 reptile species. With about 5,528 plant and 760 animal endemic species.

There are a total of 222 endangered species of which, 31 are facing extinction, 89 are classified as vulnerable, 22 are rare species and 80 have an indefinite status.

Peru is also rich in ecosystem biodiversity with the major biomes being marine, mountain, forest, freshwater and agricultural ecosystems. Peru also has very high cultural diversity with 14 linguistic families, and 44 distinct ethnic groups, of which, 42 are found in the Amazon[25].

Fifth National Report

Peru mentions DRR in its NR5, highlights flood/storm surge, sea level rise, drought, food security, fire and erosion, as prevalent hazards in the country, it does not however mention specific targets related to DRR or hazards.

Challenges highlighted in the NR5 related to the implementation of EbA in Peru include:

- Need to articulate actions to achieve targets, as there is no planning for implementation of strategy and little consistency in progress
- Address threats to mountain and forest ecosystems, caused by land-use change, climate change, deforestation and extractive industries. Meanwhile inland water ecosystems suffer contamination, degradation, damming and overfishing

Lessons learned:

- Lack of knowledge of biodiversity and the real state of ecosystems in Peru
- Mechanisms and process for evaluation and environmental auditing
- Necessity to strengthen capacities for conservation management approaches within the National Service of Natural Protected Areas of Peru (SERNANP)
- Conservation of high biodiversity areas is a priority for the Ministry of Environment (MINAM) and Ministry of Agriculture (MINAGRI)
- Recovery of vulnerable and threatened species

National Biodiversity Strategy and Action Plan (NBSAP)

The vision of the strategy is that by 2021, Peru will be the first country in the world to have the best benefits for its population from its conserved and sustainably used biodiversity, as well as having restored all its biodiversity components in order to meet the basic needs and well-being for present and future generations.The overall objective of the NBSAP is the conservation of biodiversity, sustainable use of its components, fair and equitable sharing of the benefits arising from their use, adequate access to those resources, appropriate transfer of pertinent technologies, taking into account the rights to those resources and technologies, as well as appropriate financing. There are eight specific strategy lines, which have specific objectives and actions defined for each one. These are: the conservation of biodiversity in Peru; integrating sustainable use of biodiversity into the management of natural resources; establishing special measures for the conservation and restoration of biodiversity faced with external processes; promoting participation and engagement from the Peruvian society in the conservation of biodiversity; improving knowledge of biodiversity; perfecting the instruments needed for management of biodiversity; enhancing Peru's image at the international level; and implementing immediate actions.

In its NBSAP, Peru includes EbA-related aspects; which has a dual focus on both people and nature:

- Build adaptive capacity, technical capacity, education and awareness: Important progress has been made for this strategic approach, especially in relation to the educational sector, for instance, the approval of the National Environmental Education Policy (PNEA) and the National Environmental Education Plan 2013–2021 (PLANEA).
- Government/policy planning and regulatory frameworks/mainstreaming of biodiversity values into national policy:
  - Organisation of the Annual Meeting for the
  - Climate and Forest Governors

[25] CBD (n.d.). Peru – Country Profile (https://www.cbd.int/countries/profile/default.shtml?country=pe)

    - Approval of the work plan for the climate change technical commission
- Manage threats to biodiversity, e.g. invasive species (AIS): monitor pressure caused by invasive species and living modified organisms
- Natural resource management (fisheries, forests): Specific objective 2 of the National Aquaculture Development Plan: increase private investment in aquaculture by increasing appropriate areas for this sector
- REDD+ related pilot project implementation has occurred in forested National Protected Areas (ANP), in addition to other key areas in the country.

Additionally, as part of Initiative 20x20, Peru has committed a total of 3.2 million hectares for restoration by 2020; this will be achieved through the Ministry of Agriculture.

National Adaptation Plan

Peru is a country highly vulnerable to the adverse effects of climate change; it presents seven of the nine characteristics of vulnerability recognised by the UNFCCC (MINAM, 2016). Therefore, adaptation to climate change is a matter of immediate priority for the country on its way to development.

Peru has put in place several policies and strategies related to adaptation and mitigation of climate change, particularly as a key aspect to reach sustainable development. CCA has been incorporated into different State policies, and it includes other sectors and different levels of the government. The National Climate Change Strategy draft (2015) which was under public consultation last year and approved in September 2015, describes the two main objectives: adaptation and mitigation (see more in Podvin & Arellano, 20T6).

With regards to CCA, after a review of the vulnerabilities and adaptation priorities of the country, and based on the study of the national goals established by the current national planning documents (Bicentennial Plan, National Plan for Disaster Risk Management – PLANAGERD, Environmental Action Plan – PLANAA, Environment Agenda 2014) and sectoral planning documents (PLANGRACC-A11, Budget Programmes, Integral Plan of mitigation and adaptation to the effects of climate change on public health, among others), the adaptation component is formulated for different sectors and prioritised systems (Republic of Peru, 2015, p. 9).

National Disaster Management Plans

Through the DIPECHO IX project (2015–2016), the UNDP is supporting the country in the implementation of its National Plan for Disaster Risk Reduction (PLANAGERD), by promoting the coordination of the National System for Disaster Risk Reduction (SINAGERD), strengthening institutional capacities and enhancing community preparedness. Through this contribution to improving the PLANAGERD, the principal project objective is to reduce disaster risk for communities and their livelihoods.

Eco-DRR Initiatives

The Centre for Conservation, Investigation, and Management of Natural Areas (**CIMA – Cordillera Azul**), and the National Service of Natural Areas Protected by the State (**SERNANP**) have been implementing the PNCAZ National Park Programme. The programme also includes the Cordillera Azul National Park REDD Project (PNCAZ), which protects a large area of intact tropical montane forest in the San Martín, Ucayali, Huánuco and Loreto Departments, and will run from 2008–2028.

The protected area in the Peruvian Yungas ecoregion is located on the eastern slopes and valleys of the Peruvian Andes and includes intact forests ranging from the lowlands (300 m.a.s.l.) to mountain peaks (2,400 m.a.s.l.). The ecoregion forms a transition zone between the Southwest Amazon moist forests and Ucayali moist forests at lower elevations to the east and the Central Andean puna and wet puna at higher elevations to the west.

Box 11. Implementing no-regret EbA measures in the Peruvian Andes

The Nor Yauyos-Cochas Landscape Reserve (NYCLR), located in the Peruvian Andean highlands, is one of 76 natural protected areas managed by Peru's National Service of Natural Areas. In this area, a number of EbA measures were implemented by The Mountain Institute (IUCN's implementing partner) and IUCN as part of the Mountain EbA project, via a ***participatory methodology*** to select adaptation measures. EbA and Eco-DRR measures that are seen as 'no-regret' activities from the communities' perspective included:

- **Sustainable water and grassland management**, where upper micro-watersheds, water courses, and their associated vegetation (mainly grasslands) are managed to provide water storage, groundwater recharge and regulation services, and
- **Community-based sustainable native grassland management** to enhance pastoral livelihoods and increase resilience to extreme climatic events.

The process of consultation, diagnosis and design of the measures lasted eight months. Project sites were selected based on environmental, social, ecological, political and operational criteria. Field trips and workshops were carried out to identify vulnerabilities based on local perceptions, the local communities' needs and priorities, and ideas to address the vulnerabilities. Proposed activities were presented and validated by local stakeholders, reserve staff and project partners.

The participatory approaches used so far in the planning, design, validation and implementation phases have been key to delivering bottom-up activities that empower and enhance local community ownership. A recommended action for incorporating climate change adaptation into protected area systems is to follow a horizontal model of co-management, thus strengthening the governance of protected areas and enabling adaptation of the local communities and the ecosystems they depend on.

This case study outlines the importance of participatory approaches in the planning, design, validation and implementation phases of EBA and Eco-DRR measures in the Peruvian Andean highlands.

~ Global Mountain EbA Programme, funded by the German Government and implemented by UNEP, UNDP and IUCN

Source: SCBD (2016). See more in Podvin et al. (2014) and Zapata et al. (2016).

The project focuses on the montane forest, lowland forests in the watershed of the Ucayali River, and the dry forests in the buffer zone of the Huallaga River. Main objectives of the project are to protect a variety of species, biological communities, and geological formations pertaining to the montane forest of the Cordillera Azul; as well, as support the development of an integrated and sustainable management of natural resources in the buffer zone.

By conserving more than 1.3 million ha of intact montane forest and its biodiversity, the project aims to prevent deforestation in the PNCAZ, and to reduce emissions by more than 17 million tCO_2e over 10 years. A key component of this is to strengthen the protection strategy of the PNCAZ, promoting a participatory approach to involve local communities and other stakeholders in the management of the park and its buffer zone, thus generating environmental benefits. Strengthening local environmental management strategies builds local capacity for sustainable land use and improves the quality of life of communities inside the buffer zone.

To date, the most comprehensive source of information on EbA in Peru is the Mountain EbA Flagship Programme. Mt. EbA lessons have been shared through the implementing agencies' (UNDP, UNEP, IUCN and TMI) communication channels; Peru has incorporated them into national adaptation policies and priorities, such as the national environmental training programme of the Ministry of Environment (MINAM) and the development of guidelines for public investment in ecosystem service projects by the MEF. The Peru INDC even refers to the Mountain EbA Programme (among other projects) specifically in the context of results and practical experiences provided by key projects, which have informed the adaptation proposal (Republic of Peru, 2015).

In the period 2013–2015, Practical Action supported the initiative of UNEP's Regional Gateway for Technology Transfer and Climate Change Action in Latin America and the Caribbean (REGATTA), and managed the **EbA Community of Practice (EbA CoP)**. This permits the exchange of experience and knowledge on EbA to climate change. The target group are people and organisations facing similar development challenges, interested in sharing and critically reviewing experiences, and determining how best to apply lessons learned.

In 2014–2017, Save the Children and Practical Action, in coordination with the Metropolitan Municipality of Lima and the Municipality of Carabayllo, are implementing a project to reduce risk in the El Progreso sector of Carabayllo, Lima. This urban area has been prioritised as highly vulnerable to natural disasters, and as such the project aims to increase the resilience of the inhabitants. The project focuses on the Chillón River, produced by glacial melt from the Andes, and investigates risk and proposes risk reduction strategies in this urban context.

As part of the Mountain EbA Project, the 'Patronato-RPNYC' carried out a study to understand **current capacity and potential for capturing and storing water in the upper Cañete river basin**. The project is coordinated by the Nor Yauyos-Cochas Landscape Reserve Foundation (NYCLR-Patronato), along with IUCN-Sur, *Universidad Católica Sedes Sapientiae* and the RPNYC, and focuses on Lima Region, Yauyos Province in the high basin of the Cañete River, characterised by high Andean wetlands and puna grasslands.

The Nor Yauyos-Cochas Landscape Reserve (RPNYC) is located in the Lima Region, Yauyos Province and in the Junín Region, Jauja Province, in the high and middle basin of the Cañete River and in the Cochas Pachacayo basin. It lies in the Peruvian Yungas and Central Andean wet puna ecoregions. This initiative aimed to establish baseline conditions of water storage capacities of the *bofedales* and *pajonales*, as part of an **integrated water management strategy** in the basin, to increase climate resilience of the socio-ecological system.

The aim was to identify critical areas for restoring water storage capacity and to restore the capacity of the *bofedales* and *pajonales* to capture and store rainwater through: a) Establishing a baseline of the natural area from 1962; b) Implementing two restoration parcels (*bofedales* and *pajonales*) in 17 ha of land with farmer communities in Huancaya.

As part of the "**REDD+: Supporting countries and communities to design schemes for benefit sharing**" project implemented by IUCN in alliance with the Association for Research and Integral Development (AIDER) and Conservation International-Peru (CI-Peru), there have been pilot 'REDD+' activities within CI's Conservation Agreement framework implemented by CI-Peru in the Native Awajun community 'Shampuyacu' in the San Martin region in the Peruvian Amazon. Among these, restoration of riparian ecosystems to promote sustainable river basin management has taken place; specifically, riparian vegetation has been maintained (from an initiative that took place in mid-2013 before this project) and expanded, with increased vegetation cover and protecting crops from river bank erosion and flooding when river levels increase. ■

South America boasts diverse ecosystems rich in biodiversity, supporting a wide range of flora and fauna, but they also provide many services to the people inhabiting the coastal, high mountains, and Amazon areas. However, these services can only be delivered when the ecosystems are in healthy condition. Whilst it is evident that communities and local populations in the region may instinctively use natural ecosystems such as forests, natural dryland vegetation and mangroves to protect themselves against the impacts of natural hazards, unsustainable land-use practices have led to environmental degradation and left people without these vital ecosystem services, leaving them exposed to increasing risks of disasters.

Disasters due to natural hazards can have adverse environmental consequences; degraded environments can cause or exacerbate the negative impacts of disasters. Additionally, climate change will magnify existing vulnerabilities to disasters due to changing patterns of some hazards (such as heat waves and increased precipitation) in specific regions and due to increased population exposure (IPCC, 2012).

As evidenced, deaths and impacts from disasters in the region have been steadily increasing, and as such, **no-regret, cost-effective strategies are to explore and prioritise greater investment in ecosystem services for DRR**. But environmental tools for disaster reduction have not yet been widely applied by many practitioners in the region, and although DRR measures are being incorporated into environment and development planning and management in the region, there is still potential to expand this further.

Healthy and well-managed ecosystems -such as coral reefs, mangroves, forests and wetlands- reduce disaster risk by acting as natural buffers or protective barriers, for instance through flood and landslide mitigation and water filtration and absorption. At the same time, fully functioning ecosystems build local resilience against disasters by sustaining livelihoods and providing important products to local populations (PEDRR, 2010).

The impact a disaster has upon a community is largely determined by how a society manages its environment, how well prepared it is to face adversity, and what resources are available for recovery. DRR requires managing risks with different tools, and **hard and soft** interventions allow communities to become more resilient by ensuring increased capacity to cope in the face of threats from disasters.

Certainly, ecosystem management approaches can be cost-effective when compared to alternatives like engineered infrastructure; examples in the region include **integrated coastal zone management** (ICZM), **integrated water resource management** (IWRM)[26], forest landscape restoration, protected areas management and community-based natural resource management.

Eco-DRR is used to demonstrate and promote ecosystem management for DRR. In addition to being cost effective, ecosystem management approaches have the advantage of being well understood, with the benefit of having been tested in a variety of ecosystem types, in different geographical regions, and at different scales. Additionally, they are based on participatory, local ownership, social and institutional governance mechanisms – all of which are critical for DRR implementation.

[26] IWRM has been defined as "a process which promotes the coordinated development and management of water, land and related resources in order to maximise economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems" (Global Water Partnership).

Examples of Eco-DRR for biodiversity

This section will document practical examples of how Eco-DRR approaches contribute to biodiversity conservation based on the regional assessment.

Argentina: The initiatives carried out by *Fundación Hábitat & Desarrollo* contribute to biodiversity conservation by protecting wetlands, and the flora and fauna of the ecoregion (Argentine Espinal and the Paraná River[27] watershed – the southernmost portion of the Paraná ecoregion). Due to its unique characteristics, and despite its relatively small area, the ecological reserve boasts important biodiversity. The riparian zone provides important wildlife habitat, increasing biodiversity, which also serves as an important wildlife corridor. By conserving wetlands, not only is biodiversity conserved and effective flood defences preserved, but the many other benefits provided by these ecosystems are also safeguarded.

The riparian area serves as an important natural biofilter, protecting the aquatic environment from excessive sedimentation, polluted surface runoff and erosion. The restoration of these zones through revegetation plays a key role in improving water quality, but also significantly reduces soil erosion and flood damage through erosion control. The revegetation plays a specific role in stabilising the soil, keeping carbon in the ground, and protecting the land from drying out.

Bolivia: The initiatives implemented by Amazonia Services highlight the benefits of water and soil management and conservation, to promote biodiversity and the functional integrity of this ecosystem. ***Waru Waru*** ensures both effective water collection and subsequent drainage, and therefore prevents damage due to soil erosion during floods. As such, this technique is particularly interesting for areas with extreme climatic conditions, such as mountainous areas that experience heavy rainfalls and periodic droughts, and where temperature fluctuations range from intense heat to frost. It could also prove very useful in arid and semi-arid areas of the region.

The contribution to biodiversity conservation of the project "Adaptation to the Rapid Impact of Glacier Retreat in the tropical Andes" (2008–2014), includes: soil restoration in the Andean highlands, climate-resilient irrigation techniques, alternative crops and best practices in agriculture; and the prevention of landslides and flash floods due to climate change-induced accelerated glacier melting.

Chile: Although EPIC does not directly contribute to biodiversity conservation, one of the local innovations related to understanding the role of native forests and their ecosystem services, as well as promoting knowledge on this among local stakeholders, which will be taking place in the coming months, also includes relevance for biodiversity aspects (implicitly). Also, as part of these knowledge enhancement actions, the role of the Biosphere Reserve is being highlighted as a category relevant for facing CCA and DRR. Lastly, the study carried out by SLF to understand the role of native forests to protect against avalanches and landslides, has delivered scientific knowledge on the importance of maintaining the current native forest in the study area in the Valley of Las Trancas, as well as supporting with tools and information which could eventually be used to develop green-grey infrastructure to prevent avalanches and landslides specifically in the study area but also replicated in other areas in Chile.

Colombia: The land-use zoning of the *Arroyo Carolina* micro-watershed actively promotes the creation of exclusive areas for protection and restoration of the natural ecosystems in the micro-watershed. Likewise, within the management plan, mitigation measures designed to improve conditions in the watershed are proposed to protect biodiversity.

[27] The Paraná River is second in length only to the Amazon River among South American rivers.

The development of the vulnerability assessment and adaptation strategy in the *Lagunas de Fúquene, Cucunubá* and *Palacio* proposes a series of measures to reduce vulnerability and to increase the adaptive capacity of the wetland ecosystems in response to climate change. It has the objective of protecting biodiversity and thereby ensuring the vital ecosystem services provided to local communities. As CCA and DRR overlap in many cases, it is important to highlight these efforts to ensure ecosystem services that will also face risks from disasters (often aggravated by climate change impacts).

The project zone management in the high mountain landscapes of the Western Andes contributes towards ecosystem protection and restoration, with a strong focus on protected areas and buffer zones in high mountain landscapes.
The WWF promotes conservation and sustainable management of ecosystem practices for the reduction of flood risk, and green infrastructure alternatives.

The FLR activities contribute to biodiversity conservation by restoring the remnants of the dry forest ecosystem, some of which are at increasing risk of flooding, whilst others require protection from increased degradation and landslide risk on steep slopes.

Both projects coordinated by the *Corporación Ambiental La Pedregoza*, in partnership with the Alexander von Humboldt Research Institute, promoted the use of **native tree species**.

Ecuador: Through the coordinated development and management of water and land resources in the El Angel watershed, the CGRR places specific emphasis on the land management plans developed for the páramo region. This contributes towards increasing economic and social welfare in an equitable manner without compromising the sustainability of these fragile highland ecosystems.

By contributing to the biodiversity conservation of the ECOPAR project in the Chimborazo province, it thus promotes and recovers environmental practices that enable adaptation to climate change, whilst improving incomes. Sustainable natural resource management in the Andean páramos mean it is less threatened and, with time, may recover ecosystem integrity, as well as associate species.

Peru: The project carried out by CIMA – *Cordillera Azul* and SERNANP, contributes to biodiversity conservation as it protects an area of 1.3 million ha within the limits of *Cordillera Azul* National Park REDD Project (PNCAZ), and will contribute to reducing deforestation and forest degradation in its buffer zone. The conservation of this area will also generate valuable ecosystem services.

In the case of Mt. EbA and component 3 of the project, related to the implementation of EbA measures on the ground, the EbA no-regret measures implemented by IUCN and led by TMI (IUCN's implementer partner), focused on improving water availability and distribution and enhancing community management of native grasslands, addresses one of the main climate change vulnerabilities related to droughts (threatening also the main livelihood related to cattle farming). In addition, it is expected to reduce the likelihood of fires thanks to increased moisture in the grasslands, which was already seen in August 2015, when a fire in the upper part of the community of Canchayllo did not spread in the area of influence of the EbA measure because of the higher humidity.

As part of the "REDD+: Supporting countries and communities to design schemes for benefit sharing" (IUCN, AIDER and CI-Peru), the activities carried out by CI-Peru of maintaining and expanding the restoration of riparian ecosystems has increased vegetation cover, and protects crops from river bank erosion and flooding when river levels increase. Also, it has increased fruit plants which diversifies the local community's food consumption (promoting food security) and providing habitat and food for animals (increasing biodiversity conservation). This activity has also been shown to be effective in engaging local community members in conservation activities with evidence-based benefits.

Role of biodiversity in DRR in South America

This section will document practical examples of how biodiversity (different species), ecosystems (different habitat types) and means of conservation (different management approaches) contribute to Eco-DRR.

Climate change is a serious threat for local people in the region whose livelihoods depend largely on climate-sensitive activities such as agriculture and exploitation of natural resources. In this way, climate variability and change also threaten food security and agriculture in South America, but by integrating climate adaptation measures into agriculture sectors, vulnerability can be reduced, and adaptive capacity enhanced.

Healthy ecosystems contribute to reducing risk and increasing resilience for people and the environment. Preserving ecosystems such as wetlands, forests and coastal areas – including mangroves and reefs – reduces vulnerability by supporting livelihoods, while acting as physical protection to reduce the impact of hazard events. Ecosystem restoration and sustainable management of natural resources can therefore play an essential role in people's ability to prevent, manage and recover from disasters and longer term impacts of climate change. These nature-based measures not only provide cost-effective and environmentally friendly infrastructures for risk mitigation, but also enable local communities to build and sustain a safe and productive environment in the long term.

Various forms of capital are critical to ecological and community resilience. Capital is developed during phases of system growth and development. That capital, as well as the influx of capital from broader areas, is critical for system recovery and determining a system's trajectories (MEA, 2005). Especially important to natural disasters is the role of maintaining or restoring natural capital in the form of ecosystem goods and services (Liu *et al*., 2007; Olshansky & Kartez, 1998).

Wetland ecosystems – whether forested or not – are critical buffers for mitigating the impacts of hurricanes in coastal areas (Day *et al*., 2007). Floodplain ecosystems provide similar functions during extreme floods.

Mangroves play a role as natural coastal defence strategies. Mangroves can serve as '**bioshields**' or buffers to reduce the impacts of extreme weather events, waves, storm surges, swells, and sea-level rise. Overall coastal resilience (the ability of a system to cope with or recover from "shocks") to disasters and climate change impacts will be increased if mangroves are considered as an integral part of integrated coastal planning and management. In addition to their coastal protection functions, intact mangrove ecosystems are also important for food security and for sustaining human livelihoods. For example, after a particular disaster event, affected communities often rely on their environment to meet vital needs such as water, food and shelter and in locations where ecosystems and their services have been degraded, the ability of communities to adapt and recover from disaster is reduced.

In water management systems, levees and canals are designed to provide buffers against floodwaters. Examples of buffering can be found in **coastal ecosystems**. In the state of Florida, governmental policies protect coastal mangrove forests from development. These forests provide buffers against **storm surges** (Berke & Campanella, 2006), as demonstrated in south Florida in 1992, when Hurricane Andrew severely impacted coastal mangrove forests; these forests took the brunt of the wind and wave energy, thereby sparing the inland areas. Others argue that the protection of barrier islands is critical for similar reasons (Pilkey & Fraser, 2003). Following Hurricane Katrina, Day *et al.* (2007) demonstrated how management that led to the loss of coastal wetlands in Louisiana increased the vulnerability of the area to hurricane impacts.

A growing body of experimental evidence reveals how biotic diversity can stabilise ecosystems that are subject to perturbations. Biological diversity refers to both the different types of species and the different functional roles of species. Tilman *et al*. (2001) demonstrated that more diversity helped in the recovery of ecosystem functions (productivity, biogeochemical cycling) after a disturbance.

The relationship between biological diversity and resilience has been explored, and biodiversity has a positive influence on ecological resilience. For example, overgrazing in rangelands selectively removes **drought-resistant species**. When droughts subsequently occur, the system suddenly flips into a shrub-dominated ecosystem, often more prone to wildfires. Similar linkages have been found between response diversity and resilience in a range of ecological systems. Elmqvist *et al*. (2004) argue that spatial forms of **functional diversity (land-use types) build resilience** in human community landscapes.

Floods/soil erosion, sea level-rise, tsunamis

The importance of plant diversity (characteristics) for soil bioengineering in watershed management has been investigated, for example, by Oldfield and Olwell (2015), who conclude that seed production in natural ecosystems ensures the regeneration of locally adapted plant species, which provide habitat for wildlife, stabilise soils, control surface-water flow, and contribute to ecological integrity and resilience.

Whilst Petrone and Preti (2010) conducted research on the use of soil bio-engineering techniques for disaster mitigation, environmental restoration and poverty reduction in developing countries. The research focused on the characteristics of suitable autochthonal plants used in soil bioengineering for risk mitigation and environmental restoration in the humid tropics of Nicaragua. The following is a brief description of the chosen plant species:

Erythrina fusca (Lour.) (local common name: Helequeme); member of the Fabaceae family, is a deciduous tree thickly branched which at its mature stage can reach 20 m in height and about 40 cm in diameter. It is a pioneer species that, in the wild, is frequent in areas subjected to periodic flooding and along streams and waterways, generating pure stands. It requires average precipitations between 1500 and 3000 mm per year and average temperatures between 16–24 ^{o}C. It is native to the humid tropics of Central and Southern America. It is the species with the widest distribution within the genus of Erythrina, as it can grow at any altitude between 0 and 2000 m. *Erythrina fusca* is commonly used as a shadow tree in coffee and cacao plantations, but it is also used for firewood, fodder and healing (IRENA, 1992).

Gliricidia sepium (Jacq.) Steud (local common name: Madero negro); is a member of the Fabaceae family. It is a small- to medium-sized tree, reaching heights between 6 and 20 m (10 m on average), very common in Mexico and Central America. It grows well with a temperature of 20–30 ^{o}C, with precipitations between 900 and 1500 mm per year and a five-month dry season. It is used for firewood, fodder and healing (Petrone & Preti, 2008).

Tabebuia rosea (Bertol.) DC (local common name: Roble macuelizo); member of the Bignoniaceae family, is a medium-sized tree (it can reach 20 m in height), with a straight trunk and a wide, irregular crown. As far as soil is concerned, it is not very exacting. It has good climatic adaptability, and it easily colonises untended fields. It is native to central-southern America and is very common all over the territory of Nicaragua. Its red wood is highly appreciated in carpentry for furniture manufacture. *Tabebuia rosea* also has ornamental and healing uses (IRENA, 1992).

Petrone and Preti concluded that hydrological-risk mitigating actions performed on a basin scale and through naturalistic (live) interventions are not only socially and technically possible, even in hardship areas (by maximising the contribution of the local labour force and minimising the use of mechanical equipment), but also economically sustainable (Petrone & Preti, 2010).

Regarding riparian restoration, the principal goals include erosion control, channel stabilisation, runoff reduction and enhancement of wildlife and fishery habitat. In terms of species selection, Dreesen *et al*. (2001) found that the appropriate species to establish in degraded riparian zones may or may not be those present before the disturbance occurred.

An intensive study of willow (*Salix*) species on the Apache-Sitgreaves National Forests has determined the elevation range of occurrence on hundreds of sites on numerous watersheds between 5,500 and 10,000 feet (Granfelt, 2001).

Bioclimatic or ecoregion can determine species suitability in addition to elevation and latitude. As examples, Arizona sycamore (*Platanus wrightii* S. Wats.) is only a dominant species at mid- elevations in southwest New Mexico and southeast Arizona. Arizona walnut (*Juglans major* (Torr.) Heller) can be a co-dominant species in southwest New Mexico mountains while little walnut (*Juglans microcarpa* Berl.) can be a co-dominant in southeast New Mexico (Dick-Peddie, 1993).

While some are obligate riparian species (e.g. willows and cottonwoods); others are facultative or semi-riparian in that they often are found in upland areas. As examples, New Mexico locust (*Robinia neomexicana Gray*) and aspen (*Populus tremuloides Michx*.) are often found in montane riparian zones, but also form dense stands on mountain slopes after disturbance (Dick-Peddie, 1993). Obligate species are not always found in typical streamside environments. As an example, in north-central New Mexico narrowleaf cottonwood (*Populus angustifolia James*) has invaded mine overburden where the lack of competing vegetation, in part, allows soil moisture levels to build up sufficiently to support this species (Dreesen & Harrington, 1999).

Site assessment examining such factors as water table depth and fluctuation, soil texture, soil salinity, and browsing pressure from livestock and wildlife is a prerequisite to successful riparian restoration. These factors along with elevation and ecoregion considerations will aid in the selection of appropriate restoration species.

Biodiversity can make a contribution to different components of DRR, particularly **prevention and mitigation and preparedness**. For instance, the role of biodiversity in preventing or reducing the intensity of a hazard is significant. Whilst most hazards cannot be prevented, in some cases, management practices can prevent them from occurring.

We know for instance that coastal vegetation, including **mangrove forests**, provide protection from floods, sea-level rise and tsunamis. The contribution of biodiversity to this protective function has been highlighted in a study by Tanaka *et al*. (2006) in Sri Lanka and Thailand, which indicated that the identity of species and their structural characteristics can contribute to increase the protective function of vegetation against tsunamis, for example:

- Variation in horizontal and vertical structure can reduce the speed of tsunami currents.
- Complex aerial root structure of some mangrove species provides protection from tsunami damage
- Some tree species provide soft landing for people carried by currents
- Bigger trees will catch more man-made debris
- Some tree species are also effective at providing escape routes for people by having low branches

Preparedness is intended to reduce the impact of a hazard, for example, by increasing resilience (through livelihood improvement, livelihood diversification, increase in income, and contributing to people's ability to build stronger houses/infrastructures).

The main example of such avoidable hazards: **wildfire**

Preti and Petrone (2013) conducted a practical assessment of local species' suitability for soil bio-engineering work in the Santo Domingo Ecuadorian tropical region. Autochthonous plant species' survivorship and vegetative growth were evaluated in a short-term palisade experimental regime. Among the four species evaluated, *Brugmansia versicolor, Malvaviscus penduliflorus*, and *Trichanthera gigantea* performed well, evidenced by > 70% survivorship, however *Euphorbia cotinifolia* exhibited increased mortality (59%). Significant differences and notable variability in terminal shoot length and stem diameter among species indicated further study is warranted in growth parameters.

Landslides, flooding, and erosion are among the most threatening natural hazards in tropical and sub-tropical countries (e.g. Petley et al., 2005; Miner & Villagran de Leon, 2008). Soil bio-engineering techniques are considered important tools to combat erosion, shallow landslides, bank instability, desertification and drought (Schiechtl & Michaelsen, 1985). Gray and Sotir (1996) provided evidence these techniques contributed to soil strength, with positive influences on geotechnical, hydrological and hydraulic soil characteristics. Lasting beneficial effects on soil physical and chemical properties were reported in other studies (e.g. Schwarz et al., 2006; Moscatelli *et al*., 2009; Preti *et al*., 2011). It is clear soil bio-engineering methods are a low cost, environmentally conscience, and effective solution for even large-scale erosion control, and riverbank and slope protetction.

Soil bio-engineering has been implemented frequently in Europe (Evette *et al*., 2009), and has also been successful in developing countries, including Nepal (Florineth, 2004; Ghimire & Karki, 2004; Lammeraner *et al*., 2005; Acharya & Lammeranner, 2011; Rauch et al., 2011), Brazil (Sutili *et al*., 2004), Colombia (Rivera & Sinisterra, 2006), Ethiopia (Reubens *et al*., 2007), and Nicaragua (Petrone & Preti, 2008, 2010).

Once soil bio-engineering techniques are defined, appropriate plant species selection is based on the following factors: (i) function plan (catch, armour, reinforce, anchor, and support or drain, among other components); (ii) site characteristics (physical environment, climate, soil type, moisture conditions); and (iii) regional economic and social criteria (e.g. Rossi Pisa *et al*., 1999; Reza Pezeshki *et al*., 2007; Preti & Giadrossich, 2009; Acharya & Lammeranner, 2011; Osman & Barakbah, 2011).
In the framework of the "Disaster Risk Reduction in Santo Domingo de los Tsáchilas" (EU-DIPECHO) project, the present study tested the suitability of autochthonous species, recommended by local residents and experts, to establish soil bio-engineering installations in Ecuador. Our project was characterised by a strong involvement of local communities, as we shared with local people the choice of the experimental site, soil bio-engineering installations, and all monitoring procedures; we also trained people in soil bio-engineering techniques. We think this is vital because local people are one of the stakeholders, and this involvement makes it their project.

Droughts/ climatic changes

In recognition of the importance of genetic diversity for climate-resistant and resilient strains of crops, small farmers in the Andean highlands of Peru have diversified crop production in response to changes in weather patterns, by altering their planting season and varying their crops. Farmers in Chopcca now grow maize at 3,600 m.a.s.l., some 300 metres above traditional cultivated lands, and apply ancient strategies of risk diversification to adapt to the new weather conditions and their effects (Newsweek, 2008).

Pests present a significant problem; blight (a fungus-like water mould) and the Andean potato weevil, or potato white grub, are significant threats. However, the Peruvian farmers count a rich diversity of crop strains in their arsenal to confront these threats; with 2,700 native varieties of potato and 35 types of corn in the country, these species are suitable for different climatic circumstances, including length of growing season, water and nutrient requirements, and pest resistance. This highlights the importance of conserving agro-biodiversity and crop wild relatives of common crops. Therefore, expanding the stock of native varieties of potato and using organic methods for controlling pests have been useful in helping farmers adapt to climate change.

Wildfire

Prolonged drought poses a significant threat in the region, with the associated risk of increasing wildfires. Forest and natural vegetation fires represent a key disaster risk for the region, which has a direct impact on biodiversity. A related threat is the spread of invasive and noxious weeds. Oldfield and Olwell (2015), report the natural resilience of heavily grazed native grassland ecosystems weakened by the use of introduced grass species initially intended to stabilise soils and improve productivity.

Efforts to restore the land involve both tackling invasive species and restoring native plants. In the rangelands and steppes of the Great Basin and inland Pacific Northwest, cheatgrass (*Bromus tectorum*), an invasive species has spread rapidly. Cheatgrass-dominated land burns every 2–5 years. Land rich in ***sagebrush*** and other native species, in contrast, is more ecologically resilient, burning every 11–200 years (Koch *et al*., 2015).

The use of native plants, to restore biodiverse, plant-rich ecosystems, is particularly beneficial for flagship animal species, such as the greater sage grouse (*Centrocercus urophasianus*) in the Western United States. This species is heavily dependent on sagebrush landscapes and due to habitat loss over the last 100 years, bird numbers have declined dramatically. With action to prevent and suppress rangeland fire and to restore extensive fire-damaged sagebrush communities, such species will once again form a part of this ecosystem. Therefore, the use of locally adapted seeds and native plant species should be promoted, where possible, for vegetation management and restoration.

Economic case for Eco-DRR

Economic losses related to disaster reduction have reached an average of US$ 250 billion to US$ 300 billion a year, severely affecting stable economic growth in low- and middle-income countries and eroding development gains in vulnerable communities[28].

Disasters not only generate impacts in terms of economic losses (affecting economic activities and damaging infrastructure), as well as **disruption of social networks** (reducing human living standards and separating families); but they also cause negative impacts **on natural and environmental conditions**. “When an extreme event occurs there will tend to be damages to the natural capital in terms of destruction of habitat, soil degradation, water pollution, etc., leading to the loss and damage of environmental and ecological services. These impacts affect ecosystem dynamics reducing the system’s capacity to withstand natural phenomena” (ECLAC, 2010).

There are several studies regarding the role of protecting ecosystems to reduce the impact of natural disasters. For instance, an analysis of damages caused by 34 major hurricanes in the United States of America, revealed that one hectare of healthy wetland prevents, on average, US$ 33,000 of damages per hurricane; also concluding

[28] 2015 Report of the Secretary-General on the Implementation of the International Strategy for Disaster Reduction.

that the loss of wetlands around New Orleans prior to hurricane Katrina was largely to blame for the failure of the constructed sea defences (Costanza et al., 2008). The country estimated that coastal wetlands provide US$ 23.2 billion a year in storm protection services.

In New Zealand, the Whangamarino Ramsar site is the **second largest swamp complex on North Island and has a significant role in flood control** (the value of which has been estimated at US$ 601,037 per annum at 2003 values) and sediment trapping. Values can rise in years when there is flooding and it is estimated that flood prevention in 1998 was worth US$ 4 million alone. There have been 11 occasions when the wetlands have been needed to absorb floods since 1995. The site is also of considerable biodiversity value and more botanically diverse than any other large low-lying peatland on North Island (Dudley *et al*., 2013). Globally, wetlands are estimated to provide on average (year 2000 values) US$ 464 per ha per year for flood control.

Coastal systems (e.g. mangroves, seagrass beds, coral reefs) **are extremely important in protecting shorelines and vulnerable coastal communities against storm surges and sea-level rise**. The degradation of natural coastal defence accelerates coastal erosion, which in many cases may undermine the sea walls and other natural barriers. A study of the value of mangroves in Thailand found replacement costs for shoreline protection were at least US$ 3,679/ha based on a 20-year timeline. And in most cases disaster mitigation benefits are in addition to existing benefits from biodiversity conservation, livelihood, recreation and cultural values (Dudley *et al*., 2013).

Regarding the value of ecosystem services provided by restored mangroves, Cooper and colleagues (2008) estimated that the value **of the shoreline protection services provided by mangroves in Belize was US$ 140 million per year in avoided damages**. Whilst the combined value of ecosystem services that mangroves and coral reefs provide to the economy of Belize in shoreline protection, fisheries, and tourism is an estimated US$ 500 million per year.

In this sense, the economic benefits of maintaining natural ecosystems to protect against disasters are noteworthy, yet **in South America an ecosystem approach for reducing disaster impacts is only recently receiving attention with existing mitigation strategies**. Direct comparisons between the costs of investing in built infrastructure and maintaining natural habitats as protected areas are scarce, but some countries in the region are already specifically investing in habitat protection or restoration as part of DRR strategies.

For example, **Argentina** has implemented flood control projects that use the natural storage and recharge properties of critical forests and wetlands by integrating them into "**living with floods**" strategies that incorporate forest protected areas and riparian corridors (Quintero, 2007). A relatively small investment of US$ 3.6 million in wetland protection and management, as part of a total outlay of US$ 488 million in flood defences in the Paraná River basin, has now led to significant changes in state and municipal regulations in Argentina, including establishment of protected areas as part of flood protection schemes (Quintero, 2007). This incorporation of natural habitats into flood defences provided a low-cost alternative and supplement to costlier hard infrastructure, with the added benefit of high biodiversity gains through protection of 60% of birds and more than 50% of amphibians, reptiles, and mammal species. This example serves as a useful lesson on how best to harness natural habitats as green infrastructure to reduce the vulnerability of downstream communities (Lopoukhine *et al*., 2012).

Another interesting example is the **EPIC project in Chile**, which intends to demonstrate the **effectiveness and economic value of environmental management** for DRR and CCA, while bringing wider livelihoods benefits to communities; and gather empirical evidence of the value of ecosystem-based approaches to risk and hazards in many different situations. As the project is due to be finalised in 2017, the knowledge products created will no doubt provide an important source of regional relevant information on the economic aspects of Eco-DRR. This initiative is being complemented by the Ecosystem-based Adaptation approaches[29] initiative, which aims to show climate change policymakers when and why EbA is effective: the conditions under which it works, and the benefits, costs and limitations of natural systems compared to options such as hard, infrastructural approaches. It aims to promote and provide tools to support the better integration of EbA principles into policy and planning.

As part of the **Mt. EbA project in Peru**, and faced with the degradation of grasslands, two communities in the Nor Yauyos-Cochas Landscape Reserve have developed no-regret Ecosystem-based Adaptation measures focusing on the enlargement and conservation of wetlands and the community-based management of native grasslands, measures comprised by three pillars: institutional strengthening and communal organisation, strengthening capacities and local knowledge, and 'green-grey' infrastructure (implemented by TMI and IUCN). These are nature-based solutions that are supporting the communities to better manage the grasslands, water and livestock, as well as maintaining and enhancing the ecosystem's services.

As part of the activities to "determine whether the EbA measures can be economically feasible for the local communities", IUCN and TMI carried out conventional and qualitative Cost-Benefit Analysis (CBA) for the EbA no-regrets implemented in Canchayllo and Miraflores. Meetings and workshops were held to design and test the qualitative CBA methodology (with a participatory approach); this methodology was applied in both communities (see Alvarado et al., 2016). CBA qualitative analysis (that integrated the perceptions of the community including social, economic, environmental and climate change dimensions) the B/C ratio was 2.8 and 2.25 in Canchayllo and Miraflores, respectively confirming that **benefits are higher rather than costs** (Alvarado, 2015a, 2015b). Although this case focused on EbA, a DRR element relates to droughts that can be aggravated by climate change (i.e. extreme events), but showcases economic assessment tools that can be applied in Eco-DRR initiatives.

Also, using the methodology developed as part of component 4 of this project (led by UNDP), a conventional CBA was developed considering ecosystem services related to provision and water provision for farming activities in four scenarios: without climate change & without project, without climate change & with project; with climate change & without project, and with climate change & with project. **Results in all cases show that it is better to implement the project in climate change scenarios.**

There are also some interesting sources for information on a global level. For example, the **Economics of Ecosystems and Biodiversity (TEEB) initiative** is a potentially valuable source of data and could lead to a better understanding of the contribution of nature to the economies of the region specifically. TEEB and other economic valuation studies have provided evidence that nature provides services that contribute economically to human well-being, and have recommended investment in ecosystems for CCA. Furthermore, in making the case for EbA, analyses of the economic costs and benefits of these options can be useful in highlighting their cost-effectiveness (SCBD, 2016).

The Economic Commission for Latin America and the Caribbean (ECLAC) is another important resource for economic information. An assessment prepared between 1972 and 1999 revealed the

[29] http://www.iied.org/ecosystem-based-approaches-climate-change-adaptation

economic impact of natural disasters in five countries of the region (Chile, Colombia, Jamaica, Mexico and Nicaragua). Total damages reached more than US$ 50 billion; however, the report states that the impact would have been far greater but for the fact that ECLAC only assesses damages when governments have asked for assistance. Nonetheless, one of the results of this analysis sheds light on the two main factors to be considered on the assessment of environmental impacts of major disasters: (1) pre-disaster environmental degradation will enhance the vulnerability to hazards; and (2) the economic valuation of environmental assets and services are usually not reflected in the national accounting systems.

Whilst disasters do not distinguish levels of development, they usually expose inequalities where more vulnerable populations often experience the worse impacts in relation to people affected, fatalities and economic impacts. In this sense, the vulnerability of populations to natural hazards determines their impact; thus resilience and capacity to adapt to extremes are key factors to reduce vulnerabilities and exposure.

In addition to geophysical and hydro-meteorological hazards, increasingly unpredictable weather brings a new challenge, which makes it harder for communities to adapt, cope and respond to risks. Extreme climate-related events are projected to increase in frequency, intensity, spatial extent, duration and timing as a result of climate variability. The increased exposure of people and economic assets to these changes has been the major cause of long-term increases in economic losses from climate-related disasters. Hence, this points to the importance of considering disaster risk reduction also in terms of adaptation to climate variability and change rather than just mitigation of impacts.

Protected Area management: integrating biodiversity conservation and DRR

The role of **protected areas** for protecting people and their livelihoods from devastating impacts of disasters is well documented. Protected areas in the region play a vital role in conserving biodiversity and the ecosystem services on which many communities depend. However, rapid economic development, population growth and an erosion of traditional practices are resulting in habitat loss and degradation. This is putting protected areas in South America at risk and leading to serious decline in the biodiversity they harbour, which is having, and will continue to have, a devastating effect when faced with increasing climate variability and risk of disasters.

Environmental degradation already increases the risk that extreme weather events and geological events will lead to a disaster for vulnerable communities. Cleared shorelines, denuded mountain slopes, bare earth and canalised rivers provide little protection against floods, tidal surges, storms and desertification. On the other hand, people living in healthy ecosystems have a much better chance of surviving extreme weather events, without them becoming a major disaster (Dudley *et al*., 2013).

- Maintaining natural ecosystems that buffer against hazards such as tidal surge (coastal mangroves, coral reefs); flash floods (wetlands, floodplains), and landslides (forests and other native vegetation).
- Maintaining traditional/ cultural ecosystems and crops that have an important role in mitigating extreme weather events, such as agroforestry systems, terraced crop-growing and fruit tree forests in arid lands that can prevent desertification.
- Providing an opportunity for active or natural restoration of degraded ecosystems, such as reforesting steep slopes or restoring flood plains.
- Providing emergency sources of food, freshwater, building materials and living space following disasters (which, if unplanned can itself cause problems for the protected area).

Table 12. The role of protected areas in reducing natural hazards

Hazard	Role of protected area	Protected area habitat type	Examples
Flooding	Providing space for overspill of water / flood attenuation	Marshes, coastal wetlands, peat bogs, natural lakes	The two reserves that form the Muthurajawella Marsh, in Sri Lanka, cover an area of 3,068 ha near Colombo. The economic value of flood attenuation (converted to 2003 values) has been estimated at US$ 5,033,800 per year.
	Absorbing and reducing water flow	Riparian and mountain forests	Floods that had affected the coastal city of Malaga in Spain for 500 years were eliminated through reforestation and protection of an area of the watershed.
Landslide, rock fall and avalanche	Stabilising soil, loose rock and snow	Forest on steep slopes	Shivapuri National Park is the main source of water for domestic consumption in Kathmandu, Nepal. Landslide protection measures have been implemented in 12 localities in the protected area.
	Buffering against earth and snow movement	Forests on and beneath slopes	Swiss forests are managed to ensure protection of steep slopes against avalanche and landslip, with about 17% of forests protected for this purpose.
Tidal waves and storm surges	Creating a physical barrier against ocean incursion	Mangroves, barrier islands, coral reefs, sand dunes	The indigenous communities living in the Rio Plátano Reserve in Honduras are reforesting the shore of the Ibans Lagoon with mangrove and other species to improve fish habitats and counter erosion of the narrow coastal strip.
	Providing overspi ll space for tidal surges	Coastal marshes	The Black River Lower Morass marsh acts as a natural buffer against river floodwaters and incursions by the sea and is an important economic resource for 20,000 people.
Drought and desertification	Reducing grazing and trampling	Particularly grasslands but also dry forest	In Djibouti, the Day Forest is a protected area, with regeneration projects initiated to prevent further loss of this important forest area and further encroachment by deserts (UNCCD, 2006).
	Maintaining drought - resistant plants	All dryland habitats	In Mali, the role of national parks in desertification control is recognised, and protected areas are seen as important reservoir s of drought -resistant species.
Fire	Maintaining management syste ms that control fire	Savannah, dry and temperate forests and scrub	In Mount Kitanglad National Park, Philippines, volunteers from different ethnic communities in the area undertake fire -watching duties.
	Maintaining natural fire resistance	Fire refugia in forests, wetlands	Recent studies in the Amazon found the incidence of fire to be lower in protected areas relative to surrounding areas.
Hurricanes and storms	Buffering against immediate storm damage	Forests, coral reefs, mangroves, barrier islands	The protected mangrove system of the Sundarbans in Bangladesh and India helps to stabilise wetland and coastlines and contributes to buffering inland areas from cyclones.

Source: Dudley et al. (2013)

Unlike other forms of land use, **protected areas already have many important management elements in place to protect and maintain natural habitats and their functions**. Most protected areas have agreed borders, usually legally defined and physically marked. Most such areas also operate under legal or equivalent cultural frameworks. Protected areas usually have agreed governance structures. They are backed by a range of supportive policies and laws at national levels and by various conventions and agreements at regional or international level. They are supported by associated government departments, policies, guidelines and established management procedures. Protected areas also have management processes that will be useful or essential for managing ecosystem services, and many have already invested in start-up costs and can draw upon existing funding from governments or trusts; efforts towards disaster mitigation using protected areas can sometimes complement those from other sources (IUCN/WCPA, 2013).

The role of protected areas can also be strengthened by integrating them more thoroughly into existing DRR planning, for example by:

- **Rigorous economic, engineering and environmental analyses**: government institutions, universities and the private sector should be encouraged to invest in rigorous economic, engineering and environmental analysis of proposed infrastructure projects to determine when and where there are benefits of incorporating, wherever possible, complementary green and hard infrastructure into DRR plans.
- **Broad scale spatial planning**: at a national and regional/ transboundary scale, disaster relief agencies should cooperate with partners to identify places where natural ecosystems could prevent and mitigate disasters and to develop associated ecosystem protection strategies. This should include, where appropriate, the establishment of new protected areas, connectivity areas in buffer zones or outside protected areas, in vulnerable areas to safeguard vital ecosystem services that buffer communities.
- **Management plans**: some protected area authorities may consider revising management objectives and management plans in order to maximise benefits in terms of disaster reduction and to increase awareness of these values among the general public.
- **PES and financing strategies**: DRR institutions can often usefully work with protected area managers to develop *innovative financing strategies* for protected areas, which recognise PES. DRR funds should in some cases be used to establish or manage protected areas in places where these provide cost-effective DRR.
- **Restoration**: in some cases, it may be useful to *protect and restore degraded ecosystems specifically to improve their role in DRR*; in such situations, some level of active management may be required, e.g. removal of *invasive alien species* to allow natural regeneration or planting of native species to restore natural processes (IUCN/WCPA, 2013).

In addition to protected areas per se, the important role of Indigenous Peoples and Community Conserved Territories and Areas (ICCAs) in Eco-DRR is also a key consideration. ICCAs involve collective decision-making about nature, and are closely related to peoples' livelihoods, culture and identity; they can be found around the world, span all types of ecosystems and cultures, have thousands of local names and are extremely diverse. They are built on collective ecological knowledge and capacities, including sustainable use of wild resources and maintenance of agrobiodiversity.

ICCAs are typically designed to maintain livelihood resources for times of stress, such as during severe climate events, war and natural disasters. Examples of ICCAs include:

- Sacred spaces such as the Chizire sacred forest, Zimbabwe, Khumbu of the Sherpa people (Mount Everest National Park), sacred lake, Indian Himalayas;
- Indigenous territories and cultural landscapes/seascapes such as the Paruku Indigenous PA, Western Australia, Traditional territory of ASATRIZY, Yapú, Vaupés, Colombia;
- Territories and migration routes of nomadic herders/mobile indigenous peoples, such as wetlands in Qashqai mobile peoples' territory, Iran;
- Sustainably managed wetlands, fishing grounds and water bodies (Temporarily and/ or permanently forbidden sites (manjidura), Bijagos biosphere reserve, Guinea Bissau);
- Community-established, owned and managed areas in industrialised countries (Gajna floodplain commons, Croatia) (SCBD, 2016).

5 Conclusions

By James McBreen and Karen Podvin

Challenges and opportunities

At the policy level

In spite of the benefits that ecosystem-based solutions represent for more comprehensive DRR activities, there are still many challenges for them to become mainstreamed into policies and practice:

- **Promote inter-sectoral and multi-stakeholder efforts for mainstreaming Eco-DRR**: there is a need to promote inter-sectoral work on Eco-DRR and EbA in other sectors beside environment (and climate change). As well as for EbA, engaging other partners is crucial, for instance other NGOs and academia; also working with institutions such as protected areas, can provide opportunities and governance structures to integrate Eco-DRR in planning and policy instruments and implement Eco-DRR measures on the ground (Podvin *et al*., 2014). Additionally, in the context of biodiversity conservation and climate change adaptation, land use and spatial planning not only contributes to the creation of resilient lands to reduce the vulnerability of ecosystems and communities and conserve ecological services, it is also one of the best ways to link biodiversity with sectors at territorial level (Andrade & Vides, 2009).

- **Enabling conditions for Eco-DRR require a multidisciplinary approach and inter-sectoral collaboration**: Integrating Eco-DRR and EbA require bringing together different actors and expertise across sectors and encouraging multidisciplinary approaches at project implementation and policy levels (Doswald & Estrella, 2015b). In this sense, one of the main challenges relates precisely to the lack of dialogue and action between sectors, which increases the difficulties of translating policies into plans, programmes, resource allocations, and across and into development sectors. It is important for Eco-DRR and EbA to be embedded in national development plans/vision/strategy to provide an enabling framework for local-level implementation and facilitate access to budget/funds. In this regard, it is paramount to consider the impacts of actions implemented by other sectors that creates or increases vulnerability. Among the conditions, it is also important to enhance governance capacities for ecosystem-based DRR through multi-sector, multi-disciplinary platforms (PEDRR, 2010).

- **Institutional set-up matters**: In addition to having the right enabling conditions, a clear institutional framework is needed to articulate and facilitate collaboration among different institutions related to environment and disaster management. Therefore, the establishment of a policy-making and advisory body on climate change and DRR programmes and projects in each country could have the potential to enable interventions with a broader perspective by coordinating public institutions related to climate change, environment, energy, meteorology, infrastructure and disaster management. The contribution of several institutions will potentially enable to scale up field interventions (to increase the geographic scope and thus the impact of interventions), in order to facilitate replication or expand into national-level programmes and plans.

- **Arguments in favour of ecosystem-based approaches: make an economic case for Eco-DRR**: Demonstrating cost-efficiency on Eco-DRR and EbA (e.g. promoting NSB as viable options versus conventional grey infrastructure options) can support its financing overcoming the financial barrier detailed earlier. For instance, cost-benefit analyses carried out in Peru demonstrated the viability of EbA options compared to inaction or to other adaptation measures in diverse scenarios, however quantifying multiple benefits on EbA requires time, (technical) resources, and data that might not be available (UNDP, 2015; Rizivi *et al*., 2015). Rapid cost-benefit analysis of ongoing and completed projects could be an alternative and may provide arguments for decision making on EbA (Rizivi *et al*., 2015, in Podvin & Arellano, 2016).

- **The role of Regional Economic Commissions in Eco-DRR**: The role of the Economic Commission for Latin America and the Caribbean (ECLAC), regarding Eco-DRR, has until now, been minimal. However, following an informal conversation with programme officers from the ECLAC, it appears that they are planning to embark on an initiative to better understand the role of biodiversity and ecosystems in relation to DRR in the region. However, at the time of preparing this report, further details are pending.

- **Incentives should be targeted for specific stakeholders**. Factoring in incentives to ensure long-term buy-in or ownership of the interventions is key to achieving sustainability. Incentives should be targeted to national government institutions, households, etc., whilst perverse incentives should in turn, be eliminated: land tenure clarification is especially important in this point. Also, it is relevant to link Eco-DRR with sustainable livelihoods and development (PEDRR, 2010).

In this sense, there are also interesting **opportunities**:

- **There is enormous scope for integrating DRR initiatives into biodiversity elements of risk reduction**. There is wide evidence in the region of supportive policies and legislation for biodiversity conservation relevant for disaster risk. For instance, there is an increasing tendency for sustainably managed forest areas, and the participatory development of these plans. This presents an opportunity for mainstreaming the role of locally appropriate biodiversity in DRR, whilst reducing new risk scenarios and maximising social and environmental benefits.

- **Eco-DRR and EbA may be already integrated but may not be called as such**. Eco-DRR should be part of a broader DRR and CCA strategy, yet there are not enough advocacy efforts from the conservation, disaster management and climate change communities to articulate the DRR/Adaptation function of ecosystems. If decision makers and communities were sensitised alike, there would be a strong support for DRR and CCA. Thus, there is an opportunity for the development of policies, guidelines and positions; advising on regional, international and national CC and DRR obligations; disseminating information on sectoral level initiatives; advising, guiding and coordinating the development of national climate change and DRR initiatives in the countries.

At the implementation level (evidence)

The survey carried out by this assessment enabled the gathering of some interesting information regarding the challenges of implementation of ecosystem-based initiatives:

- **South America experiences significant impacts of natural hazards and disasters on biodiversity and agriculture**. Smallholder farmers in the region are highly dependent on rain-fed agriculture. Droughts and floods are occurring with increased frequency and severity. Higher temperatures impact crop growth and augment the presence of pests. The lack of soil cover and lack of organic matter in the soil means they no longer hold rainwater effectively. With intense rains, the water runs off the land quickly and causes more erosion and flooding. Depending on the management practices, agriculture is highly susceptible to climate variability and change. If no risk reduction and adaptation measures are put in place, enhanced exposure to drought will further compromise livelihoods in the region. This is of particular significance, as 35 million people in South America were affected by droughts between 2000–2015. In this sense, evidence suggests that there is a necessity for enhanced mainstreaming of DRR and resilience building within the agricultural sectors in the region.

- **There is a need for greater investment in Eco-DRR to build resilient livelihoods and food production systems**. The impact of different types of hazards on agriculture subsectors varies substantially, which requires context-specific DRR and management. Eco-DRR measures should pay specific attention to crops that contribute most to food security and nutrition. A common priority identified by the survey respondents is the necessity to ensure sustainability beyond a project-based lifetime. In light of the lack of information on baseline conditions, the development of peer-reviewed databases could contribute to better informed nationally and/or locally appropriate risk reduction funding and investments.

- **Eco-DRR does not lend itself to easy identification of measurable targets or goals**. The existence of data gaps represents a significant challenge; especially in terms of effective data collection and its inclusion in national and regional analysis. Ecosystem and environmental benefits are still hard to measure (e.g. percentage of disaster losses reduced due to well-functioning ecosystems, monetary savings by wetlands preservation for flood reduction, etc.). The benefits of sustainable ecosystem management are spread across so many sectors that the topic does not receive singular attention from any of them (e.g. agriculture, health, education, culture or DRR). In addition, there remain many critical gaps between best practices and the reality of current DRR and CCA measures.

- **Raise awareness and infuse the ecosystem bases approaches for CCA and DRR**: although there are institutional settings and strategies/policies in the region, there is still a need to raise awareness on the crucial role of ecosystems to strengthen ongoing CCA and DRR efforts. Eco-DRR and EbA need to be consolidated and 'operationalised' at national, regional and local levels through feasible and tested tools and mechanisms.

- **Lack of recognition and capacity on the role of biodiversity and DRR amongst civil society, and especially local communities**: there is a need to challenge the idea of living with risks and the absence of regard for the role of nature. Therefore, there is a need to enhance evidence-based knowledge and capacities among implementers and communities on the diversified benefits of nature-based solutions for DRR.

Several **opportunities** were also identified:

- **EbA approaches enable the integration of climate change considerations in special planning efforts**. The incorporation of EbA approaches in spatial planning efforts (e.g. in land management plans, local development plans, watershed management plans, and departmental development plans) is the best way to ensure that local governance takes climate change into account, addressing climate change impacts. It is also relevant to consider that ecosystem-based approaches for CCA and DRR also have their limitations. Understanding these, as well as when and how these approaches work, their benefits and costs, is imperative for its implementation, replication and scaling-up.

- **A decrease in threat levels will allow natural ecosystems to become more resilient to increasing** variability and climate change. Nature-based solutions are more cost-effective and successful when facing climatic change challenges. More diversified agricultural systems can mitigate climate-related impacts up to a point, providing habitats and also connectivity between fragments of natural habitats. The region does have some excellent experiences involving farmers, communities, CSOs, NGOs and institutions who have come together to better respond to variable conditions, implementing farming strategies such as water conservation through watershed management and agroecological farming, including crop and livelihood diversification.

- **Environmental benefits from agroecological practices enhance DRR**. For instance, adaptation of high-mountain farming systems decreases the pressure on natural ecosystems, such as the fragile páramos in the Andes. Environmental benefits include the reduction in soil erosion, and thus of road, dam and hydroelectric power plant maintenance costs; the improvement of water quality and quantity; improvement of air quality; increase in biodiversity; and, carbon sequestration. Agroecological practices help farmers to develop soil, water and ecosystem management techniques that restore productivity and make farms and ecosystems more resilient, thereby enhancing food security and control over resources for DRR and resilience at local level.

- **Information availability needs to be improved**. A decrease in climate change vulnerability of local communities will occur once information on the effects of climatic variation is available, progress in local organisational processes is made, and a better reconnaissance of the land has been carried out.

- **Nature-based solutions including ecosystem management and biodiversity conservation generate multiple benefits besides DRR**: The examples provided throughout the assessment, show that the diverse initiatives that include ecosystem management besides reducing risks to disasters, also support other aspects such as climate change adaptation and mitigation (such as EbA, FLR and REDD+) as well as co-benefits, including livelihood diversification and enhancement, food security, traditional knowledge and practices.

- **Building understanding, capacities and engagement of communities and civil society on the role of biodiversity and DRR**: there is a need to continue promoting capacity building and institutional strengthening among public, private and civil society stakeholders directly involved with landscape management for EbA internalisation and implementation on the ground.

- **Consolidate experiences and progress and upscale ecosystem-based approaches**: in the specific case of IUCN-Sur, continue working on the diverse initiatives jointly with members, governments, other NGOs, academia (for instance, EPIC, RELIEF Kit and EbA approaches projects) as well as creating synergies with other initiatives to promote ecosystem-based approaches for CCA and DRR in policies and strategies.

At the knowledge base

One of the main challenges in terms of the Eco-DRR knowledge base is the insufficient technical understanding among stakeholders to develop tools and models to facilitate proactive use of ecosystems as a DRR/adaptation measure:

- **Rigorous DRR based on biodiversity should include cross-sector coordination to prioritise conservation interventions through the assessment of threats to biodiversity and natural ecosystems**. The different disaster risks in South America include: floods, drought, wildfires, tsunamis, earthquakes, etc., whilst different threats to biodiversity include: sea-level rise, deforestation, ecosystem degradation (caused by agricultural expansion for crops and livestock, infrastructure, extractive industries, etc.). The level of threat could be spatially quantified and mapped together with ecosystems, in order to better understand DRR in priority regions and biodiversity opportunities specific to these areas.

- **Generate and share solid evidence and cost-effectiveness of ecosystem-based approaches**: There have been several experiences worldwide on EbA (for instance, see Rizivi, 2014) that have been providing evidence of the environmental and socio-economic benefits and added value of EbA as CCA options. However, further knowledge and understanding on the limitations, gaps, costs and benefits need to be evaluated and disseminated among EbA practitioners and policy makers (Rizivi *et al.*, 2015).

However, there are several opportunities to improve the knowledge base already in place:

- **The EbA approach is integrated within an overall adaptation and DRR strategy**. This approach includes essential measures, such as: preparing for emergency intervention; reviewing the climate change fitness of existing structural protection measures; enhanced coordination between spatial planning and risk management; setting up and optimising long-term monitoring and warning systems; establishing a risk culture and initiating risk dialogue; and strengthening individual preparedness and precaution.

- **The Red List of Ecosystems (RLE) provides a global standard for risk assessment of worldwide ecosystems, and is applicable to global, regional, national or local level**. The RLE methodology uses a set of criteria based on evidences of ecosystem collapse, measured through the reduction of area, geographical distribution, and on degradation of key physical and biotic components and processes (Keith, 2013). The RLE in South America includes descriptions for the 200 units (based on vegetation macrogroups); and is at varying stages in Bolivia, Colombia, Chile, Costa Rica, Ecuador, Paraguay, Peru, Uruguay, Venezuela, and several large regions (states, watersheds) in Brazil. This tool can support gathering and assessing ecosystems' status and consider measures to restore or maintain ecosystems and their services and functions against risks to disasters. In general, it utilises existing instruments and tools in ecosystems management and enhances their DRR value (PEDRR, 2010).

- **Fostering exchange of experiences and best practices in the region**. The ability of communities to anticipate natural disasters can in large part be facilitated by the predictive capacity of knowing when and where a disaster might occur, and anticipating the impact of those disasters on communities, which both rely on past experience or the history of disasters. In this sense, the role of documentation, shared learning and active engagement, in terms of past experience and resilience, should be recognised and promoted in the region. Local strategies could influence decision-making processes to promote sustainable management practices.

- **Mainstreaming local environmental management in the planning process**. There is an opportunity to include DRR based on biodiversity cross-sector coordination to prioritise conservation interventions through the assessment of threats to biodiversity and natural ecosystems. The level of threat could be spatially quantified and mapped together with ecosystems, in order to better understand DRR in priority regions and biodiversity opportunities specific to these areas.

Key messages

South America, as with other regions of the world, is exposed to diverse, and ever-increasing natural hazards, including: floods, droughts, wildfires, earthquakes, tsunamis, among others. As evidence suggests, climate change can magnify existing vulnerabilities, thus posing a serious threat to climate-sensitive activities that sustain people's livelihoods. Generally, most of the hazards cannot be prevented, yet management practices can reduce their intensity and impact. Extreme impacts on human, ecological or physical systems can result from individual extreme weather or climate events, from non-extreme events where exposure and vulnerability are high, or from a compounding of events or their impacts (flash floods, landslides). High vulnerability and exposure are generally the outcome of skewed development processes, for example, environmental mismanagement, demographic change, rapid and unplanned urbanisation, failed governance, and a scarcity of livelihood options (IPCC, 2012).

In this context, biodiversity contributes greatly to the ability of ecosystems to withstand natural phenomena by acting as natural buffers or protective barriers. Environmental degradation has a direct effect in leaving populations exposed to increasing risks of disasters. Thus, by integrating ecosystem-based solutions, vulnerabilities can be reduced and adaptive capacity enhanced. The impact of a disaster is related to how society manages its environment and how well prepared it is in terms of resilience and capacity to adapt. In this sense, resilient and adaptive land-use systems and measures to conserve or restore functional ecosystems that support sustainable human development, while preserving the natural resource base of future generations in South America and beyond are of utmost importance.

As relatively low-cost, locally accessible solutions, Eco-DRR is an opportunity to promote improved ecosystem management for DRR. Natural infrastructure can reduce hazard impacts and vulnerability, and by integrating biodiversity elements into DRR initiatives and highlighting the key role of ecosystem restoration and sustainable management of natural resources, Eco-DRR presents a broader perspective to reduce potential risk scenarios, whilst maximising social and environmental benefits, which include livelihood benefits for human well-being, regardless of a disaster event.

The importance of maintaining and restoring natural ecosystems to protect against disasters is becoming increasingly recognised, yet in South America the link between Eco-DRR and DRR is only recently receiving more attention. Although specific Eco-DRR initiatives are scarce, most of the countries are investing in ecosystem protection and restoration as a component of different projects. Therefore, in order to reinforce the link between DRR and biodiversity in South America, it is necessary to support more national Eco-DRR awareness in government plans and programmes, for instance through workshops with countries' Ministry of Environment, Ministry of Agriculture, Ministry of Energy, Ministry of Water, Ministry of Infrastructure, Ministry of Planning, Disaster Management Authority, Meteorological Authority, etc. In this way, attempting to strike a better balance between economic and social needs of the local communities and protecting ecosystems for future generations.

It is also necessary to continue to promote the non-conservation sector to talk about how they can use natural infrastructure as part of the infrastructure agenda, so that nature-based solutions are complementary to other investments coming from hard engineering used for DRR and climate change adaptation. Benefiting from the fact that nature-based solutions help reduce costs, increase cost-effectiveness, whilst increasing the co-benefits that go alongside DRR and adaptation, including biodiversity conservation.

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Annex

Annex

1

Country selection matrix

RELIEF Project
Country Selection (South America)
Prepared by IUCN-Sur (K. Podvin, A.Mora and J. McBreen)
Jan 28-2016

	Criteria	Values	Country											
			Argentina	Brazil	Bolivia	Chile	Colombia	Ecuador	Guyana	Paraguay	Peru	Surinam	Uruguay	Venezuela
1	Previous work on CCA with IUCN-Sur (and partners) in the last 5 years	0 - 1	0	0	0	1	1	1	0	0	1	0	0	0
2	Previous work speficifically on Eco-DRR with IUCN-Sur within the last 5 years	0 - 1	0	0	0	1	0	0	0	0	0	0	0	0
3	Presentation of 5th National Report to CBD	0 - 1	1	1	1	1	1	1	1	0	1	1	1	1
4	Institutions on DRR (well integrated to Ecosystems)	0 - 1	0	1	0	1	1	1	1	1	1	0	1	0
5	Feasibility to revise information regarding country size	0 - 1	1	0	1	1	1	1	1	1	1	1	1	1
6	Vulnerability to disasters by natural phenomena	0 - 3	3	3	3	3	3	3	1	2	3	1	1	2
	Total		5	5	5	8	7	7	4	4	7	3	4	4
	Selected countries		*		*	*	*	*			*			

Previous work on CCA with IUCN-Sur (and partners) in the last 5 years	
Country	Detail of projects
Argentina	
Brazil	
Bolivia	
Chile	EPIC
Colombia	El Clima Cambia, Cambia tú también; Comunidades de los Páramos
Ecuador	El Clima Cambia, Cambia tú también; Comunidades de los Páramos
Guyana	
Paraguay	
Peru	El Clima Cambia; Comunidades de los Páramos; EbA Montaña
Surinam	
Uruguay	
Venezuela	

Previous work speficifically on Eco-DRR with IUCN-Sur within the last 5 years	
Country	Detail of projects
Argentina	
Brazil	
Bolivia	
Chile	EPIC
Colombia	
Ecuador	
Guyana	
Paraguay	
Peru	
Surinam	
Uruguay	
Venezuela	

Annex

2

Vulnerability matrix

RELIEF Project
Country vulnerability to disasters (South America)
Prepared by RELIEF-Kit consultant (James McBreen)
Jan 27 - 2016

Criteria			Country											
			Argentina	Bolivia	Brazil	Chile	Colombia	Ecuador	Guyana	Paraguay	Peru	Surinam	Uruguay	Venezuela
Number of hazard types			9	8	7	6	7	7	2	6	8	1	3	4
Number of affected (2000-2015)			1,175,519	3,259,248	41,849,413	4,261,095	10,127,984	1,264,484	409,774	2,535,301	8,582,249	31,548	140,712	291,075
Total deaths (2000-2015)			351	890	2877	917	2581	349	34	116	3589	5	23	231
Total damage [US$ '000] (2000-2015)			3,744,210	1,169,500	13,581,870	32,094,000	3,454,000	1,181,475	648,800	61,820	900,050	–	70,000	333,000

Number of hazard types	0-3	1
	4-6	2
	7-9	3
Number of affected	0-	1
	1,000,00 1-	2
	>	3
Total deaths	0-300	1
	301-500	2
	>501	3
Total damage	0-	1
	1,000,00 1-	2
	>	3
Vulnerability	0-4	1
	5-8	2
	9-12	3

Source: Prepared by the author based on data provided by EM-DAT – Emergency Events Database (2016). The International Disaster Database – Centre for Research on the Epidemiology of Disasters (CRED): Country profiles. Université catholique de Louvain Brussels – Belgium. Retrieved from: http://www.emdat.be/country_profile/index.html

Criteria		Values	Country											
			Argentina	Bolivia	Brazil	Chile	Colombia	Ecuador	Guyana	Paraguay	Peru	Surinam	Uruguay	Venezuela
Number of hazard types		0 - 3	3	3	3	2	3	3	1	2	3	1	1	2
Number of affected (2000-2015)		0 - 3	2	3	3	3	3	2	1	2	3	1	1	1
Total deaths (2000-2015)		0 - 3	2	3	3	3	3	2	1	1	3	1	1	1
Total damage [US$ '000] (2000-2015)		0 - 3	3	2	3	3	3	2	1	1	1	0	1	1
Vulnerability to disasters			10	11	12	11	12	9	4	6	10	3	4	5

Stakeholder matrix

Country	Organization/Institution	Direction/Instrument	Environment	Climate change	Agriculture	Hydrology	Meteorology	Security	Disaster	Risk	Name	Position	Email
Argentina	Administración de Parques Nacionales (APN)		X						X	X	Mario Santos Beade	Fundación Vida Silvestre Argentina (FVSA) & APN	camptuyu@ rpm-net.com.ar
											Ana Balabusic	Directora Nacional de Conservación de Áreas Protegidas	abalabusic@ apn.gov.ar
											Claudio Chehebar	Director Delegación Regional	cchehebar@ apn.gov.ar
											Patricia Marconi	President, Fundación Yuchan	huaico1709@ gmail.com
	Asociación Amigos de los Parques Nacionales Perito Francisco P. Moreno										Norberto Ovando		ongparquesnacionales@ yahoo.com
	Asociación Argentina de Consorcios Regionales de Experimentación Agrícola (AACREA)			X	X						Cristian Feldkamp	Coordinador del área de ganadería de AACREA	feldkamp@ agro.uba.ar
	Centro de Relevamiento y Evaluación de Recursos Agrícolas y Naturales		X		X	X	X			X	Andrés C. Ravelo	Ing. Agrónomo Agrometeorología.	ravelo@ crean.agro.uncor.edu
	Centro Desarrollo y Pesca Sustentable (CeDePesca)		X								Alejandra María Cornejo	Responsable Pesquería merluza stock norte en Centro Desarrollo y Pesca Sustentable (CeDePesca)	alejandra.cornejo@ cedepesca.net
											Ernesto Julio Godelman	Chairman/President	ernesto.godelman@ cedepesca.net
	Cruz Roja Argentina	Gestion de Riesgo y Desastres: Sr. Pablo BRUNO							X	X	Sr. Pablo Bruno	Director de Gestion del Riesgo de Emergencias y Desastres	pbruno@ cruzroja.org.ar
	European Commission - Humanitarian Aid & Civil Protection (DG ECHO)												
	Food and Agriculture Organization of the United Nations												
	Fundación Ambiente y Recursos Naturales			X							Ana di Pangracio	Directora Ejecutiva Adjunta	adipangracio@ farn.org.ar
	Fundación Biodiversidad		X	X							Tomas Waller	Director de Conservación	twaller@ fibertel.com.ar
	Fundación Ecológica Por Una Vida										María Elena Torresi	Directora Ejecutiva	funecovidamejor@ infovia.com.ar
	Fundación Habitat y Desarrollo		X								Gustavo Aparicio	Director de Conservación	gustavo@ habitatydesarrollo.org.ar gusaparicio@ gmail.com
											Fernando Ardura	Director Ejecutivo	ardura@ infovia.com.ar
	Fundación para la Conservación y el Uso Sustentable de los Humedales			X						X	Daniel Blanco	Director Ejecutivo	deblanco@ humedales.org.ar
											Claudio Baigun	Coordinador Programa Conservación de Pecesy Pesquerías	cbaigun@ gmail.com
	Fundación Patagonia Natural			X							Jose María Musmeci	Vicepresidente	jmusmeci@ patagonianatural.org
											Guillermo Caille	Coordinador Proyecto SIAPCM (GEF-PNUD)	gcaille2003@ yahoo.com.ar
	Fundación ProYungas										Alejandro Diego Brown	Presidente	administracion@ proyungas.org.ar
	Fundación RIE - Red Informatica Ecologista										Amanda Bertolutti	Presidenta	bertolutti@ yahoo.com
	Fundación Urundei										Alonzo Zarzycki	Secretario General	alonzozarzycki@ hotmail.com
											Alejandro Zarzycki	Vicepresident & Executive Director	urundei@ yahoo.com
	Fundación Vida Silvestre Argentina		X								Fernando Miñarro		fernando.minarro@ vidasilvestre.org.ar
											Andrea Michelson	Coordinadora Programa Áreas	andrea.michelson@ gmail.com
											Carolina Dydzinsky	Secretaria de Dirección	carolina.dydzinsky@ vidasilvestre.org.ar
											Manuel Marcelo Jaramillo	Director de Conservación	manuel.jaramillo@ vidasilvestre.org.ar
	Instituto Nacional de Tecnología Agropecuaria - Bariloche				X						Verónica Rusch		vrusch@ bariloche.inta.gov.ar
	Ministerio de Agricultura, Ganadería y Pesca (MINAGRI)			X	X	X					Marcelo Di Bella	Director: Instituto de Clima y Agua - CIRN - CNIA – INTA	seree@ cancilleria.gob.ar
	Ministerio de Ambiente y Desarrollo Sustentable	Dirección de Cambio Climático		X							Nazareno Castillo Marín	Asesor de Cambio climático de la Secretaría de Ambiente y Desarrollo Sustentable / Punto Focal sobre Cambio Climático	ncastillo@ ambiente.gov.ar
											Lucas di Pietro	Punto Focal para la Adaptación al Cambio Climático	ldipietro@ ambiente.gov.ar
		Dirección Nacional de Gestión del Desarrollo Sustentable	X	X							Graciela Barreiro		gmbarreiro@ gmail.com
		Secretaría de Ambiente y Desarrollo Sustentable	X	X							Ms. Vanina Pietragalla	Technical Advisor Dirección de Conservación del Suelo y Lucha contra la Desertificación	vpietragalla@ ambiente.gob.ar
											Nadia Silvia Boscarol		ndbscrl@ gmail.com
											Santiago Schauman		santischauman@ hotmail.com
		Dirección de Conservación del Suelo y Lucha contra la Desertificación (DCSyLcD)	X	X									desersuelo@ ambiente.gob.ar
	Ministerio de Defensa	Instituto Geográfico Militar						X	X		María Isabel Sassone	Responsable de la Dirección de Sensores Remotos.	isassone@ ign.gob.ar
	Ministerio de Desarrollo Social	Plan Nacional de Abordaje Integral (Plan						X		X			planahi@ desarrollosocial.gob.ar
	Ministerio de Planificación Federal, Inversión Pública y Servicios	Política y Estrategia Nacional de Desarrollo y Ordenamiento Territorial	X		X	X		X					confed@ minplan.gov.ar
	Ministerio de Relaciones Exteriores y Culto	Secretaría de Relaciones Exteriores							X	X	Secretaría Privada		seree@ cancilleria.gob.ar
		Comisión Cascos Blancos							X	X			comunicacion@ cascosblancos.gob.ar
	Dirección Nacional de Políticas de Seguridad y Protección Civil	Sistema Federal de Emergencias (SIFEM)						X					proteccioncivil@ ssi.gov.ar
	Ministerio de Agricultura, Ganadería y Pesca			X				X			Carla Pascale Medina	Punto focal Programa Iberoamericano de Cooperación en Gestión Territorial (PROTERRITORIOS)	cpasca@ minagri.gob.ar
	Red Argentina de Municipios Frente al Cambio Climático												boletin@ ramcc.net
	Asociación Geológica Argentina									X			secretaria@ geologica.org.ar
	Servicio Meteorológico Nacional						X						
	Sistema Federal de Emergencias										Hugo Bilbao	Director Nacional de Protección Civil	
	United Nations Development Programme	Ambiente y Desarrollo Sostenible	X	X	X				X	X	Daniel Tomasini	Coordinador de Ambiente y Desarrollo Sostenible	daniel.tomasini@ undp.org
	United Nations Office for Disaster Risk Reduction (UNISDR)												
	Universidad Nacional de Chilecito			X						X	Néstor Bárbaro	Director Instituto de Ambiente de Montaña y Regiones Áridas (IAMRA)	nbarbaro@ undec.edu.ar
											Maria Dolores Juri	Directora Escuela Ciencias Biológicas	mdjuri@ gmail.com
											Stephan Halloy		shalloy@ gmail.com
	Universidad Nacional de Córdoba	Facultad de Ciencias Agropecuarias Agrometeorología		X	X		X				Andrés Ravelo	Director Científico	ravelo1@ crean.agro.uncor.edu.ar
	Universidad Nacional del Comahue - Neuquén										Adriana Otero		petiotero@ hotmail.com
	Universidad para la Cooperación Internacional										Stanley Arguedas Mora		stanley@ uci.ac.cr
	Universidad Tecnológica Nacional	Unidad de Investigación y Desarrollo de las Ingenierías, FRBA	X	X							Pablo Canziani	Investigador Principal CONICET	canziani@ uca.edu.ar
	*Plataforma Nacional para la Reducción del Riesgo de Desastres			X		X				X	Federico Bert	Investigador en temas de variabilidad y cambio climático e hidrología	fbert@ agro.uba.ar

Country	Organization/Institution	Direction/Instrument	Environment	Climate change	Agriculture	Hydrology	Meteorology	Security	Disaster	Risk	Name	Position	Email
Bolivia	Amazonia Sostenible		X								Oscar Saavedra Arteaga		osaavedraus@yahoo.com
	Asociación para la Conservación, Investigación de la Biodiversidad y el Desarrollo Sostenible		X	X							Carmen Miranda Larrea	Presidenta	cemirandal@gmail.com
	Bolivian Mountain Institute		X	X							Dirk Hoffmann		dirk.hoffmann@bolivian-mountains.org
	CARE										Luis Salamanca	Oficial Nacional de Enlace	luis.salamanca@bo.care.org dipechobol@gmail.com
	Centro de Apoyo a la Gestión Sustentable del Agua y el Medio Ambiente "Agua Sustentable"			X							Paula Pacheco Mollinedo	Directora Regional Centro de Apoyo a la Gestión Sustentable del Agua y el Medio	paulis_p@hotmail.com paula@aguasustentable.org
											Carlos Carafa	Director Ejecutivo	carlos@aguasustentable.org
	Conservation International										Juan Carlos Ledezma		jledezma@conservation.org
											Cadido Pastor		cpastor@conservation.org
	Cruz Roja Bolivia			X				X	X				cruzrobo@caoba.entelnet.bo
	Direcciones de Gestión de Riesgos									X			
	European Commission - Humanitarian Aid & Civil Protection (DG ECHO)												
	Food and Agriculture Organization of the United Nations	Unidad de Emergencias y Rehabilitación									Einstein Tejada	Coordinador Nacional Unidad de Emergencias y Rehabilitación	einstein.tejada@fao.org
		Unidad de Emergencias y Rehabilitación									Rosse Mery Noda	Sub Coordinador Nacional Unidad de Emergencias y Rehabilitación	Rosse.Noda@fao.org
	Fundación para el Desarrollo del Sistema Nacional de Áreas Protegidas										Sergio Eguino	Director Ejecutivo	seguino@fundesnap.org
	Fundación para la Conservación del Bosque Chiquitano (FCBC)										Roberto Vides-Almonacid	Director Ejecutivo FCBC	robertovides@fcbc.org.bo
	Instituto de Ecología		X								Mario Baudoin		mariobaudoin@gmail.com
	Instituto para la Conservación de Ecosistemas Acuáticos (ILPEC-ICEA)		X								Alejandro Moscoso		artmoscoso@hotmail.com
	Liga de Defensa del Medio Ambiente			X						X	Marisabel Paz	Coordinadora Ejecutiva	marisabel@lidema.org.bo
	Ministerio de Defensa Nacional	Viceministerio de Defensa Civil y Cooperación al Desarrollo Integral (VIDECICODI)					X	X			Carlos Mariaca Ceballos Omar Pedro Velazco		info@defensacivil.gov.bo
		Dirección General de Atención Emergencias y Auxilio (DGAEA)					X	X			Gonzalo Lora Araoz	Director General de Emergencia y Auxilio	coenbol@yahoo.es
		Dirección General de Prevención y Reconstrucción (DGPR)							X	X			info@defensacivil.gov.bo
	Ministerio de Desarrollo Rural y Tierras			X	X			X			Nemesia Achacollo Tola	Ministra de Desarrollo Rural y Tierras Punto focal Programa Iberoamericano de Cooperación en Gestión Territorial (PROTERRITORIOS)	despacho@agrobolivia.gob.bo
	Ministerio de Medio Ambiente y Agua (MMAyA)	Programa Nacional de Cambio Climático (PNCC)		X									
	Ministerio de Planificación del								X				
	Ministerio de Relaciones Exteriores y Culto							X					
	Naturaleza, Tierra y Vida										Ivan Arnold Torrez	Director	ivanarnoldt@gmail.com
	OXFAM	Disaster Risk Reduction and Adaptation		X					X	X	Roger Quiroga B	Coordinator DRR and Adaptation	RQuiroga@oxfam.org.uk
	Programas de Desarrollo Estratégico y Monitoreo Ambiental										Ximena Silva Maturana		xisima@gmail.com
	Programa de Reducción de Riesgos de Desastres (PRRD)								X	X			
	Protección del Medio Ambiente Tarija			X							Rodrigo Ayala	Director Ejecutivo	rayala@prometa.org.bo
											Roberto Cabrera Balvoa	Director de planificación	rcabrera@prometa.org.bo
	Secretaría Técnica del Consejo Nacional para la Reducción de Riesgos, Atención de Desastres y/o Emergencias (CONARADE)		X	X	X	X	X	X	X	X			
	Servicio Nacional de Meteorología e Hidrología (SENAMHI)					X	X						
	United Nations Development Programme (UNDP)												
	United Nations Office for Disaster Risk Reduction (UNISDR)												
	Wildlife Conservation Society (WCS)		X								Lilian Painter		lpainter@wcs.org
											Oscar Gonzalo Loayza		oloayza@wcs.org
											Robert Wallace		rwallace@wcs.org

Country	Organization/Institution	Direction/Instrument	Environment	Climate change	Agriculture	Hydrology	Meteorology	Security	Disaster	Risk	Name	Position	Email
Chile	Centro del Agua para Zonas Áridas y Semiáridas de América Latina y el Caribe (CAZALAC)					X							
	Comisión Nacional de Riego (CNR)					X							
	Comité Nacional de Protección Civil	Actúa como plataforma nacional para la reducción de desastres						X	X	X			
	Comité Nacional pro Defensa de la Fauna y Flora										Mauricio Valiente	Secretario General	secretaria.general@ codeff.c
											Ximena Salinas González	Presidenta	presidencia@ codeff.cl
											Yendery Cerda	Directora	ycerdac@ gmail.com
											Simón Gatica	Encargado del Área Técnica	proyectos@ codeff.cl
	Cruz Roja Chilena			X					X	X			
	Dirección Meteorológica	Sección Investigación y Meteorología Aplicada					X				Mr. Benito Piuzzi Miranda	Sección Investigación y Meteorología	bpiuzzi@ meteochile.cl
	European Commission - Humanitarian Aid & Civil Protection (DG ECHO)												
	Food and Agriculture Organization of the United										Kyran (Ken) Thelen		kyranthelen@ gmail.com
	Fundación Natura									X			
	Fundación para la Promoción del Desarrollo			X							Flavia Liberona	Directora Ejecutiva	fliberona@ terram.cl
	Instituto Sinchi			X									
	Ministerio de Agricultura	Unidad Nacional de Emergencias Agrícolas y Gestión de Riesgos Agroclimáticos		X	X					X	Mr. Nicolás Alvear Buccioni	Unidad Nacional de Emergencias Agrícolas y Gestión de Riesgos Agroclimáticos	nicolas.alvear@ minagri.gob.cl
		Instituto de Desarrollo Agropecuario (INDAP)			X								
	Ministerio de Medio Ambiente												
	Ministerio de Obras Públicas	Unidad de Meteorología y Nieve, División de Hidrología, Dirección General de Aguas				X	X				Ms. Marcela Oyarzo Baez	Unidad de Meteorología y Nieve, División de Hidrología, Dirección General de Aguas	
	Ministerio de Relaciones Exteriores	Subsecretaría de Relaciones Exteriores Proceso de Gestión de Riesgos											
	Ministerio del Interior	Dirección Nacional de la Oficina Nacional de Emergencia (ONEMI)						X	X				
	Parques para Chile										Karl Yunis	Director	karl@ parquesparachile.cl
	Pontificia Universidad Católica de Chile										Juan Oltremari		joltrama@ puc.cl
	Servicio Hidrográfico y Oceanográfico de la Armada de Chile (SHOA)	Chilean National Water Resource Strategy 2012 – 2025				X							
	United Nations Development Programme (UNDP)	Área de Desarrollo Local									Alberto Parra	Coordinador Área de Desarrollo	alberto.parra@ undp.org
		Gestión de Riesgos y Recuperación Post Desastre									Pablo Marambio	Oficial de Gestión de Riesgos y Recuperación Post Desastre	pablo.marambio@ undp.org
	United Nations Office for Disaster Risk Reduction (UNISDR)												
	Universidad Austral de Chile										Paulo Corti		paulo.corti@ gmail.com
	Universidad de Chile										Alejandro León Carolina Clerc		

Country	Organization/Institution	Direction/Instrument	Environment	Climate change	Agriculture	Hydrology	Meteorology	Security	Disaster	Risk	Name	Position	Email
Colombia	Academia Colombiana de Ciencias Exactas Fisicas y Naturales		X	X						X	Miguel Gonzalo Andrade	Coordinador Comité Nacional de Parques Naturales	mgandradec@unal.edu.co
	Alexander von Humboldt Institute										Nancy Aguirre		cnaguirre@hotmail.com
	Asociación Calidris										Noemi Moreno Salazar		noemisa7@yahoo.es
											Luis Fernando Castillo	Executive Director	lfcastillo7@gmail.com
	Conservation International		X	X							Angela Andrade Pérez		aandrade@conservation.org
											Matha Zarate Ospina		zaratemalu@gmail.com
	Corporación Ecoversa	Climate Change National Policy									Fabián Ignacio Navarrete	Director Ejecutivo	navarrete.fabian@ecoversa.org
	Corporación OSSO										Nayibe Jiménez Cristina Rosales Yuliana Díaz		
	Corporación para el Desarrollo Sostenible del archipiélago de San Andrés, Providencia y Santa Catalina (CORALINA)										Durcey Alison Stephens Lever	Director	direccion@coralina.gov.co
		Subdirección de Gestión Ambiental	X	X							Opal Marcela Bent Zapata	Subdirectora de Calidad y Ordenamiento Ambiental	opalb@coralina.gov.co
	Cruz Roja Colombiana (CRC)	Proyecto DIPECHO NDS							X	X	Edwin Pinto	Coordinador Nacional del Proyecto DIPECHO NDS	edwin.pinto@cruzrojacolombiana.org
		Proyecto DIPECHO							X	X	Natalia Garcia Palencia	Oficial de Comunicación del proyecto DIPECHO	natalia.garcia@cruzrojacolombiana.org
	Defensa Civil Colombiana							X					
	Departamento de Planificación Nacional								X				
	European Commission - Humanitarian Aid & Civil Protection (DG ECHO)												
	Empresa de Acueducto y Alcantarillado de Bogotá ESP										German Galindo Hernandez	Director de Medio Ambiente	ggalindoh@acueducto.com.co
	Food and Agriculture Organization of the United Nations	Unidad de Coordinación y Rehabilitación de Emergencias (UCER)									Teresita Gongora	Coordinadora UCER Colombia	teresita.gongora@fao.org.co
	Fundación Humedales			X							Mauricio Valderrama	Director Ejecutivo	mvalde@fundacionhumedales.org
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	Fundación Malpelo y Otros Ecosistemas Marinos										Ximena Tapias	Representante Legal Suplente	info@fundacionmalpelo.org
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	Humboldt University										Dario Zambrano Cortes		dgzambranoc@gmail.com
	Instituto de Hidrología, Meteorología y Estudios Ambientales de Colombia (IDEAM)		X			X	X						
	Instituto de Investigación de Recursos Biológicos Alexander von Humboldt	Laboratorio de análisis espaciales		X							Ana María Hernández	Head, International Affairs, Policy and Cooperation Office	ahernandez@humboldt.org.co
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	Ministerio de Relaciones Exteriores							X					
	Ministerio del Interior y Justicia	Dirección de Gestión del Riesgo						X	X	X			
		Unidad Nacional para la Gestión del Riesgo de Desastres (UNGRD)							X	X			
	Parques Naturales Nacionales	Conservación y manejo de áreas protegidas									Yasmin Gonzalez	Director de Oficina de Manejo de Riesgos	jazmin.gonzalez@parquesnacionales.gov.co
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	United Nations Development Programme (UNDP)												
	Unidad Nacional para la Gestión del Riesgo de Desastres (NGRD)	Directo General							X		Carlos Iván Márquez	Director General	carlos.marquez@gestiondelriesgo.gov.co
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Country	Organization/Institution	Direction/Instrument	Environment	Climate change	Agriculture	Hydrology	Meteorology	Security	Disaster	Risk	Name	Position	Email
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											Fabio Donoso	Coordinador de Proyecto	fabio.donoso@ ec.care.org
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	Corporación para la investigación, capacitación y apoyo técnico para el manejo sustentable de los			X							Robert Hofstede	Director ECOPAR	hofstederobert@ gmail.com
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	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH										Nadia Manasfi		nadia.manasfi@ giz.de
	Dirección de Gestión Ambiental del Gobierno Autónomo Descentralizado de la Provincia del Carchi										Guillermo Rodríguez	Director	grodriguez@ carchi.gob.ec
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	Fundación Charles Darwin para las Islas Galápagos										Patricia Jaramillo	Investigadora Senior	patricia.jaramillo@ fcdarwin.org.ec
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	Fundación Pro-Bosque										Eric Horstman	Executive Director	horstman.eric2@ gmail.com
	Instituto Geofísico							X		X			
	Instituto Nacional de Meteorología e Hidrología					X	X						
	Ministerio Coordinador de Seguridad	Plan Nacional de Desarrollo						X					
		Agenda Nacional Estratégica de Seguridad, Soberanía y Democracia	X	X	X			X	X				
	Ministerio de Agricultura, Ganadería, Acuacultura y Pesca (MAGAP)	Dirección de Planeamiento de la Seguridad y Riesgos			X			X		X			
	Ministerio de Inclusión Económica y Social (MIES)										Valeria Chiriboga	Especialista de Relaciones Internacionales	
	Ministerio de Relaciones Exteriores		X	X				X		X	Pamela Rocha	Directora de Coordinación de Asuntos Estratégicos, encargada	asuntosestrategicos@ cancilleria.gob.ec
	Ministerio del Ambiente		X								Roberto Marcos Miranda	Asesor de Despacho	roberto.marcos@ ambiente.gob.ec
		Subsecretaría de Cambio		X							Diego Guzmán	Director de ACC	diegog.guzman@ ambiente.gob.ec
	Plan Internacional	Reducción del Riesgo de Desastres (RRD)									Tathiana Moreno	Coordinadora RRD	tathiana.moreno@ planinternational.org mtathian@ yahoo.com
											Oscar Robles	Coordinador de Proyecto	roni@ andinanet.net
	Secretaria de Gestión de Riesgos									X	Dalton Andrade Rodríguez		
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											Estefanía Baquerizo	Coordinadora de Proyecto	estefania_b@ hotmail.com
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	United Nations Office for Disaster Risk Reduction (UNISDR)										Daniel Arteaga	Oficial de Enlace Regional y Ecuador	dipechoecu@ eird.org
	Universidad San Francisco de Quito	Instituto de Ecología Aplicada									Günter Reck	Director	gunter.reck@ gmail.com
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	World Wide Fund for Nature										Tarsicio Granizo		tarsicio.granizo@ wwf.org.ec

Country	Organization/Institution	Direction/Instrument	Environment	Climate change	Agriculture	Hydrology	Meteorology	Security	Disaster	Risk	Name	Position	Email
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	Alianza Andes Tropicales		X								Armando Valdés-Velásquez		armando.valdes@ alianzaandestropicales.org
	Asociación Amazónicos por la Amazonía		X	X						X	Rosa Karina Pinasco Vela	Presidente	k.pinasco@ ampaperu.info
	Asociación para la Investigación y el Desarrollo Integral			X							Jaime Nalvarte Armas	Director Ejecutivo	jnalvarte@ aider.com.pe
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	Asociación Peruana para la Conservación de la Naturaleza (APECO)										Liliana Ayala	Directora Ejecutiva (e)	leayala@ apeco.org.pe
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	Autoridad Nacional del Agua	Dirección de Conservación y Planeamiento de Recursos Hídricos	X	X		X					Ms. Dora Soto	Dirección de Conservación y Planeamiento de Recursos Hídricos	dsoto@ ana.gob.pe
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	Centro de Prevención de Desastres (PREDES)								X				
	Centro Nacional de Estimación, Prevención y Reducción del Riesgo de Desastres (CENEPRED)								X	X			
	Centro Peruano de Estudios Sociales										Mr. Laureano Del Castillo		laureano@ cepes.org.pe
	Conservation International										Luis Espinel		l.espinel@ conservation.org
	Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) GmbH										Stephan Amend		stephan.amend@ giz.de
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	European Commission - Humanitarian Aid & Civil Protection (DG ECHO)												
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	Fondo Verde										María Laura Lapalma	Directora de Cooperacion Internacional	cooperacion@ fondoverde.org
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	Grupo Técnico de Trabajo de Gestión de Riesgos de Desastres (GTTGRD)								X	X			
	Instituto de Montaña			X							Florencia Zapata	Subdirectora de Desarrollo Institucional	florenciaz@ mountain.org
	Instituto Nacional de Defensa Civil (INDECI)	Sistema Nacional de Defensa Civil						X	X	X			
		Sistema de Información sobre Recursos para la Atención de Desastres (SIRAD)						X	X				
		Plataforma Nacional de Reducción del Riesgo de Desastres							X	X			
	Ministerio de Agricultura y Riego (MINAGRI)	Plan de Gestión de Riesgo y Adaptación al Cambio Climático en el Sector Agrario período 2012 2021- (PLANGRACC, 2010-2011)		X	X	X				X			
	Ministerio de Defensa							X					clandeo@ patronatorpnyc.org
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	Ministerio del Ambiente (MINAM)	Dirección General de Cambio Climático, Desertificación y Recursos Hídricos (DGCDRH)	X	X		X							
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	Servicio Nacional de Meteorología e Hidrología (SENAMHI)					X	X						
	Sistema Nacional de Gestión del Riesgo de Desastres (SINAGERD)								X	X			
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	The Nature Conservancy (TNC)		X								Fernando Ghersi Penalillo		fghersi@ tnc.org
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	United Nations Educational, Scientific and Cultural Organization (UNESCO)										Massimiliano Tozzi	Coordinador nacional	m.tozzi@ unesco.org
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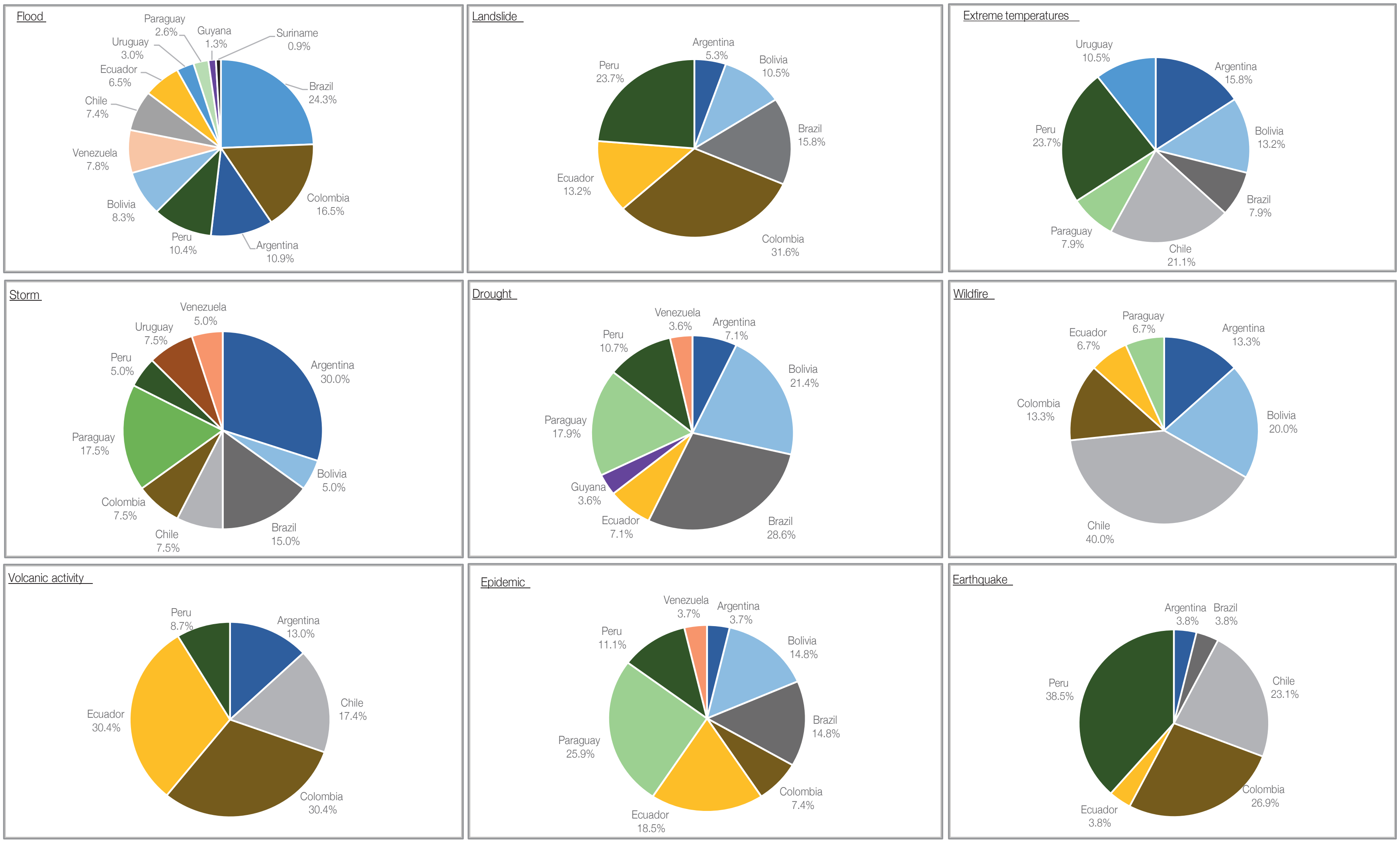
Share of occurrence by disaster type per country | 2000-2015



Source: Own elaboration based on EM-DAT (2016)

UICN

UICN-Sur — Proyecto RELIEF Kit

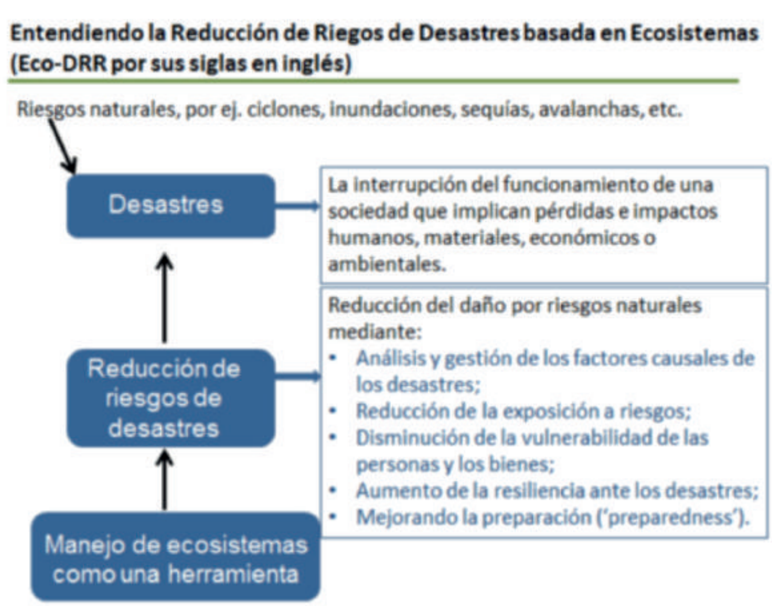
11%

Proyecto
"Resiliencia mediante la Inversión en Ecosistemas – conocimiento, innovación y transformación de la gestión de riesgo" (RELIEF-Kit)

Evaluación sobre Reducción de Riesgos de Desastres basada en Ecosistemas y Biodiversidad en América del Sur

Objetivo de la encuesta: documentar y mapear las experiencias e iniciativas sobre reducción de riesgos de desastres basada en ecosistemas y biodiversidad en seis países en América del Sur (Argentina, Bolivia, Chile, Colombia, Ecuador y Perú).

Esta información será relevante para analizar los vínculos entre la reducción de riesgos de desastres, el manejo de ecosistemas y la conservación de la biodiversidad, para generar productos de conocimiento y fortalecimiento de capacidades para tomadores de decisión, gestores de conservación y otros actores relevantes en la región. Las mismas evaluaciones se están realizando en otras 5 regiones a nivel mundial.



Sig.

UICN

UICN-Sur — Proyecto RELIEF Kit

Caracterización de la institución/organización

22%

1. *Nombre de la institución/ organización*

Nombre

País

2. *Tipo de institución/ organización*

3. *Datos personales del/a encuestado/a*

Nombre

Cargo

Teléfono

Email

4. *¿Cuál es el objetivo/misión de su institución? (marque con una "X" la/s opción/es que más corresponda/n)*

Gestión y reducción de riesgo de desastres

Desarrollo sostenible

Conservación / Gestión de recursos naturales

Otro

Ant. Sig.

UICN

UICN-Sur — Proyecto RELIEF Kit

Caracterización de la institución/organización

33%

5. *¿Cuáles son las actividades de su institución relacionadas a la gestión de desastres, reducción de riesgos, gestión ambiental, gestión de ecosistemas, y/o adaptación al cambio climático? (marque con una "X" la/s actividades que corresponda/n)*

Adaptación al cambio climático basada en comunidades (*Community-based Adaptation – CbA*)	
Adaptación basada en ecosistemas (*Ecosystem-based Adaptation – EbA*)	
Conservación de la biodiversidad	
Gestión ambiental	
Gestión de ecosistemas	
Gestión de recursos hídricos	
Manejo de áreas protegidas	
Preparación ante desastres por fenómenos naturales	
Recuperación y reconstrucción después de desastres por fenómenos naturales	
Respuesta a Desastres / Emergencias	
Sistema de Alerta Temprana	

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Actividades y experiencias de reducción de riesgos de desastres basadas en ecosistemas

44%

6. ¿Su institución actualmente implementa o tiene previsto implementar proyectos de reducción de riesgos de desastres basados en ecosistemas? (entendida como las acciones de manejo, conservación y restauración de ecosistemas para reducir el riesgo de desastres por fenómenos naturales)

○ Si

○ No

En caso afirmativo, pasar a la pregunta 7
Si es negativo, pasar a la pregunta 8

7. Utilizando la siguiente tabla, sírvase facilitar información de las iniciativas/proyectos relacionadas a la reducción de riesgo de desastres basada en ecosistemas implementadas por su institución

Título de proyecto #1

Duración

Ubicación/región geográfica

Tipos de ecosistemas involucrados

Socios

Principales objetivos

Principales resultados

Resumen de las principales actividades

¿El proyecto contribuye a la conservación de la biodiversidad?
Si la respuesta es sí, ¿cómo?

¿Existen productos comunicacionales (reportes, material de capacitación, publicaciones, etc.) del proyecto? (de ser posible, incluya hipervínculos)

Comentarios adicionales

Puntos focales del proyecto (nombre y email)

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Actividades y experiencias de reducción de riesgos de desastres basadas en ecosistemas

56%

8. *Utilizando la siguiente tabla, sírvase facilitar información de las iniciativas/proyectos relacionadas a la reducción de riesgo de desastres basada en ecosistemas implementadas por su institución*

Título de proyecto #2

Duración

Ubicación/región geográfica

Tipos de ecosistemas involucrados

Socios

Principales objetivos

Principales resultados

Resumen de las principales actividades

¿El proyecto contribuye a la conservación de la biodiversidad?
Si la respuesta es sí, ¿cómo?

¿Existen productos comunicacionales (reportes, material de capacitación, publicaciones, etc.) del proyecto? (de ser posible, incluya hipervínculos)

Comentarios adicionales

Puntos focales del proyecto (nombre y email)

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Actividades y experiencias de reducción de riesgos de desastres basadas en ecosistemas

67%

9. *Utilizando la siguiente tabla, sírvase facilitar información de las iniciativas/proyectos relacionadas a la reducción de riesgo de desastres basada en ecosistemas implementadas por su institución*

Título de proyecto #3

Duración

Ubicación/región geográfica

Tipos de ecosistemas involucrados

Socios

Principales objetivos

Principales resultados

Resumen de las principales actividades

¿El proyecto contribuye a la conservación de la biodiversidad?
Si la respuesta es sí, ¿cómo?

¿Existen productos comunicacionales (reportes, material de capacitación, publicaciones, etc.) del proyecto? (de ser posible, incluya hipervínculos)

Comentarios adicionales

Puntos focales del proyecto (nombre y email)

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Actividades y experiencias de reducción de riesgos de desastres basadas en ecosistemas

78%

10. *¿De no contar con iniciativas de reducción de riesgo de desastres basada en ecosistemas (Eco-DRR) en su institución, cuál(es) considera que son las principales causas? (marque con una "X" la/s causa/s que más corresponda/n)*

No se relaciona a la misión/objetivos de la institución	☐
Limitaciones financieras	☐
Falta de interés de los tomadores de decisiones a nivel nacional	☐
Falta de interés de los tomadores de decisiones a nivel internacional	☐
Falta de capacidad de la institución (recurso humano, administrativo, financiero, etc.)	☐
Otra:	☐

11. En el caso de que su institución sí haya trabajo o trabaje en estos temas, ¿cuáles considera usted que son las necesidades de su institución para fomentar las capacidades relacionadas con la implementación de la reducción de riesgo de desastres basada en ecosistemas?

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Experiencia con aspectos económicos

89%

Experiencia con los aspectos económicos relacionados a la reducción de riesgo de desastres basada en ecosistemas

12. *¿Su institución ha estado/está involucrada en el análisis cuantitativo sobre los beneficios económicos de la reducción de riesgo de desastres basada en ecosistemas (en comparación a otros métodos de la RRD que no son basados en ecosistemas)?*

- ○ Si
- ○ No

En caso afirmativo, sírvase detallar a continuación mayor información sobre los productos comunicacionales relacionados (reportes, material de capacitación, publicaciones, etc.)

13. *En caso de que su institución cuente con información económica de reducción de riesgos de desastres basado en ecosistemas, marque con una "X" la información más relevante*

Evaluación económica de pérdidas asociadas a desastres por fenómenos naturales	☐
Evaluación económica de costos de reconstrucción post-desastre	☐
Evaluación económica de la infraestructura construida para la reducción de riesgo de desastres basada en ecosistemas	☐
Evaluación económica de otras actividades para la reducción de riesgo de desastres basada en la naturaleza	☐

14. *Sírvase detallar a continuación cualquier otra información que usted considere relevante sobre la/s evaluación/es económicas antes mencionadas en la pregunta anterior*

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Muchas gracias por completar esta encuesta!

100%

Ant. | Listo

International agreements and policy processes relevant for Eco-DRR

A number of international agreements and policy processes related to the environment and sustainable development have called on countries to implement ecosystem-based approaches that contribute to their response to climate change, because this is seen as an important option for achieving their goals. Some examples of relevant decisions include:

- In addition to decisions on mitigation actions in the Land Use, Land Use Change and Forestry sector, the UN Framework Convention on Climate Change (UNFCCC) has invited Parties to make use of ecosystem-based approaches to adaptation, and established a database of practical examples.
- The Strategic Plan of the Convention on Biological Diversity (CBD) includes a target on contributing to climate change mitigation and adaptation through conservation and restoration of ecosystems; the Conference of the Parties of the CBD has also invited countries to implement ecosystem management activities as a contribution towards achieving the objectives of the UNFCCC.
- In this light, a noteworthy mention is also the Visión Amazónica: "A finales de los años noventa, se creó un Programa Regional de Planificación y Gestión de Áreas Protegidas de la Región Amazónica. En 2008, basándose en los logros de la Subred de áreas protegidas amazónicas y la OTCA, y como parte de los esfuerzos regionales para la implementación del Programa de Trabajo del CDB de Áreas Protegidas (PTAP), REDPARQUES lideró el desarrollo de una "Visión para la conservación de la diversidad biológica y cultural del bioma Amazónico basada en los ecosistemas".
- Integración de las Áreas Protegidas del Bioma Amazónico (IAPA) – Visión Amazónica es un proyecto financiado por la Unión Europea, que busca generar una red de trabajo en torno a los sistemas de áreas protegidas ubicados en la región amazónica.
- Áreas Protegidas, Soluciones Naturales al Cambio Climático – SNACC: Áreas Protegidas de la Amazonia son clave ayudando a las comunidades y a la naturaleza en la adaptación al cambio climático. Éstas construyen resiliencia y ayudan a mitigar los impactos durante los eventos de un clima cambiante.
- The Strategic Plan of the UN Convention to Combat Desertification calls on Parties to introduce or strengthen mutually reinforcing measures to address desertification and land degradation and climate change mitigation and adaptation, while also addressing biodiversity issues.
- The Ramsar Convention on Wetlands has invited its Parties to undertake action on peatlands and climate change, including by improving the available information on carbon sequestration in peatlands and on good practice in peatland restoration.
- The Sendai Framework for Disaster Risk Reduction – the successor instrument to the Hyogo Framework for Action (HFA) 2005–2015: Building the Resilience of Nations and Communities to Disasters – calls on countries to strengthen the sustainable use and management of ecosystems and implement integrated environmental and natural resource management approaches that incorporate disaster risk reduction.

Because of the many additional benefits that ecosystem-based approaches to climate change can provide, it is likely that actions of the type outlined in this document will also contribute to the implementation of other environmental, social and development-related policies, including at the national and subnational level (SCBD, 2015).

- The Partnership for Environment and Disaster Risk Reduction (PEDRR) represents global coordination of ecosystems for adaptation and DRR between UN agencies, NGOs and specialist institutes.
- The International Strategy for Disaster Reduction – ISDR (Estrategia Internacional para la Reducción de Desastres) reflects a major shift from the traditional emphasis on disaster response to disaster reduction, and in effect seeks to promote a culture of prevention[30]. The United Nations Office for Disaster Risk Reduction (UNISDR) is the secretariat of the International Strategy and mandated by the UN General Assembly to ensure its implementation.

DIPECHO Programme [31]

The European Commission's Department of Humanitarian Aid and Civil Protection (DG-ECHO) was established to provide rapid and effective support to the victims of crises outside the European Union. With a presence in the Latin America and Caribbean region since 1996, ECHO has contributed to reduce risk conditions in the event of disasters, and contribute to increase people's, communities' and countries' resilience in the region, through their Disaster Preparedness Programme (DIPECHO).

ECHO launched its DIPECHO in 1996, in recognition of the importance of pre-emptive measures, targeting vulnerable communities living in the main disaster-prone regions of the world. Projects are intended to demonstrate that simple and inexpensive preparatory measures, particularly those implemented by communities themselves, can be effective in limiting damage and saving lives when disaster strikes.

Typically, DIPECHO-funded projects cover training, capacity-building, awareness-raising, early-warning, and planning and forecasting measures, with the funds being channelled through aid agencies and NGOs working in the regions concerned.

DIPECHO projects are designed as pilots within their region, their impact being multiplied when the strategies they advocate are integrated into long-term development projects, whether by the development services of the European Commission, national governments or other development partners. Ultimately, DIPECHO's primary goal is to ensure the integration of disaster reduction measures into wider national policies: from education to building codes to health.

Key elements can be divided into two groups, those related to the quality and impacts of DRR processes, and those contributing directly to their institutionalisation:

▪▪▪

[30] UNISDR. What is the International Strategy? https://www.unisdr.org/who-we-are/international-strategy-for-disaster-reduction

[31] European Commission (2004). The DIPECHO Programme: Reducing the impact of disasters.

Key elements and teachings from the evolution of the DIPECHO Programme	
In regards to quality and impact	***In regards to institutionalisation***
Humanitarian aid does not begin after a disaster	Local work contributes to institutionalisation
Flexibility and adaptation contribute to achieving a better impact	Consulting and participation towards appropriation and collective construction
Actions focused on communities and their participation contributes to protecting and saving lives	Dialogue between governments allows for significant, long - lasting change
Collaboration and complementary between actors improves efficacy and efficiency	Investment in local capacities strengthens DRR institutionalisation
The development and use of appropriate tools contributes to improving quality	The promotion of rights, inclusion and equity approach provokes change in key sectors
Humanitarian aid and disaster risk reduction are part of the development process	

Healthcare and education sectors have been made aware of and educated on the importance of DRR integration (Ecuador, Peru, etc.).

Several municipalities and local governments have joined the Resilient cities campaign (DIPECHO projects): Peru – 35 municipalities; Ecuador – 8 municipalities; Colombia – 8 municipalities.

The Iberoamerican Network of Climate Change Offices (RIOOC) was created in 2004 by the Iberoamerican Ministers of the Environment at their IV Forum Meeting. A total of 21 country Climate Change Offices belong to the RIOCC: Argentina, Bolivia, Brazil, Chile, Colombia, Costa Rica, Cuba, Ecuador, El Salvador, Spain, Guatemala, Honduras, Mexico, Nicaragua, Panama, Paraguay, Peru, Portugal, Dominican Republic, Uruguay and Venezuela.

The general aim of the Network is to constitute an engagement tool between the Iberoamerican countries to integrate climate change considerations into the highest political dialogue, to promote strategies focused on sustainable development and low-carbon economies and to identify the common problems and solutions in the context of impacts, vulnerability and adaptation to climate change.

The specific objectives of the Network are the following:

- To guarantee a constant and fluent dialogue, which will allow a better knowledge of the priorities, difficulties and experiences of the Iberoamerican countries in climate change policies.
- To favour an effective implementation of the decisions of the UNFCCC, in particular those regarding adaptation and mitigation.
- To promote capacity and knowledge building, including among other subjects, technology transfer, systematic observation and options for adaptation to climate change.
- To contribute to the rapprochement of the countries' positions in the international negotiation forums on climate change and sustainable development.
- To promote the integration of climate change within the strategies of official development aid, without undermining the already existing funds for cooperation under this criteria.
- To facilitate the relationship among the public and private sector in our countries, making possible to increase the benefits of the Clean Development Mechanism (CMD) projects, working jointly in the identification and elimination of barriers to CDM.

- To promote the competitiveness of the region and the access to the market, in a way that facilitates the identification and development of supply and demand within CDM.
- To favour the signing and application of memorandums of agreement.

Iberoamerican Programme of Impacts assessment, vulnerability and adaptation to Climate Change (PIACC)

The global aim of the PIACC is to strengthen the development and application of adaptation strategies in the region by making the most of the countries' strengths and interests, and to facilitate assistance to all the members of the RIOCC in the evaluation of impacts, vulnerability and the adaptation options to climate change.

The Programme was conceived as an instrument for exchanging knowledge and experiences within the RIOCC framework, which will facilitate North-South and South-South cooperation and will enhance adaptation capacity to climate change in the Latin American region. Along with this, the Programme contributes to adaptation to climate change issues within the UNFCCC framework, due to the multiple connections between adaptation initiatives carried out under both initiatives.

Among the specific objectives to be achieved in a continuous way are the following:

- Strengthening of the institutional frameworks.
- Search for synergies with regional institutions and initiatives working on adaptation to climate change in Ibero America.
- Support climate and climate change research, and systematic observation.
- Empower exchange and availability of knowledge, experiences, methods and tools to evaluate Impacts, Vulnerability and Adaptation to Climate Change.
- Promote the development of participative projects on adaptation to climate change in priority sectors and systems, giving special importance to trans-frontier projects, trans-sectorial projects and/or pansectorial projects.
- Promote information and communication activities of the PIACC.
- Produce evaluation reports of work on impacts, vulnerability and adaptation to climate change in Ibero America.

Overview of regional policies, strategies and frameworks related to EbA and Eco-DRR in the region

Agency/convention	Programme, policy, strategy or framework	Description	Linkages to EbA and Eco-DRR (examples)
Sendai Framework for Disaster Risk Reduction 2015 - 2030	Framework to implement the International Strategy for DRR	Guidelines for an Action Plan for the implementation of the Sendai Framework for DRR 2015-2030 in America.	Yes, includesecosystems-based approach to DRR.
United Nations Office for Disaster Risk Reduction (UNISDR)	Through the Regional America's Office.	Coordinate DRRand to ensure synergies between activities of the United Nations and regional organizations on disaster reduction and activities in socio - economic and humanitarian fields.	
Regional Platform for DRR in America Regional Platforms in the region in Panama, 2009 2011 Mexico, 2011 Chile, 2012 Ecuador, 2014	Network	Gathers key stakeholders and actors in DRR and resilience to consolidate substantive and political contributions from the Americas as key inputs towards the development of the post-2015 framework for DRR.	Ecosystems are mentioned: "Foster horizontal and triangular cooperation to favor the exchange of good practices and stimulate strengthening local, national and regional capacities that take into consideration trans-boundary elements and shared resources in terms of ecosystems, watershed management, cultural aspects, among others" art. 36. Platform webpage: http://eird.org/pr14 -eng/index.html ; Final Communiqué of the 2014 platform: http://eird.org/pr14 -eng/docs/ Communique_Guayaquil_PR14_29May14.pdf
UNFCCC	National Adaptation Plans (NAPs) / Intended Nationally Determined Contributions (INDCs)	Means of identifying medium - and long-term adaptation needs and developing and implementing strategies and programmes to address those needs / Undertakings in adaptation planning	Argentina , "The promotion of biodiversity conservation and AbE" in their CCA efforts. Bolivia : "Mother Earth" comprehensive approach - CCA in water, forests and agriculture sectors. Chile: Sectoral biodiversity CCA Plan Colombia: CCA efforts includeSocio- EbA. Ecuador: prioritizes ecosystems as one of the sectors for CC efforts, and risk management. Peru: highlights vulnerability, and protecting ecosystem services in CCA efforts.
Countries	DRR plans / programs	Management of risks to disasters	Argentina : National program for prevention and DRR (EbA , EcoDRR not mentioned). Bolivia : "Risk Management Law", mention ecosystems for risk mitigation; Risk Management for the Water and Environment. Chile: Thematic table for risk management and DRR– multi -sectorial platform, including environmental sector. Colombia: National Plan of Disaster Risk Management "A Strategy for Development" – synergies of CCA and DDR, and socio EbA. Ecuador: Secretariat for Risk Management – links between CCA and DRR, and ecosystems prior itized Peru: National Plan for Disaster Risk Reduction– mentions ecosystem protection relevant for DRR

Source: prepared by Karen Podvin based on desk research

Cooperation agreement / multilateral agreement	Description	Linkages to EbA and Eco - DRR
Organization of American States (OAS)	The OAS is an intercontinental organization founded on 30 April 1948, in order to foster regional solidarity and cooperation among its member states. Many mandates, treaties, agreements and declarations were made in the OAS with respect to a wide range of environmental topics.	The OAS has undertaken various mandates with respect to ecosystems, climate change, adaptation, restoration, conservation, and biodiversity: http://www.summit-americas.org/sisca/env.html as well as mandates related to disaster risk reduction: http://www.summit-americas.org/sisca/dm.html . Some programs related to disaster risk reduction have been implemented through the Inter-American Network for disaster mitigation http://www.rimd.org/
UNASUR	The UNASUR is an intergovernmental regional organization comprising all 12 South American countries formally established in 2011 with objective to build a space for cultural, economic, social and political integration, while respecting the reality of each nation.	Within the objectives of UNASUR are aspects related to climate change adaptation, ecosystems and water: "Objective 7 Protection of our biodiversity, water resources and ecosystems as well as cooperation among Member States in matters of disaster prevention and the fight against the causes and effects of climate change" http://www.unasursg.org/en/node/180 Due to its recent formation no further action on these matters has yet been implemented by UNASUR.
Community of Latin American and Caribbean States (CELAC)	The CELAC is a regional bloc of Latin American and Caribbean states created on December 3, 2011, with the signature of The Declaration of Caracas. It consists of 33 sovereign countries in the Americas representing roughly 600 million people. Its regional parliament has a commission on environment and tourism which elaborated a declaration on climate change http://www.parlatino.org/es/comisiones-permanentes/medio-ambiente-y-turismo The CELAC also includes a working	The 2015 and 2016 Political Declarations and their action plans include commitments with respect to climate change, biodiversity, adaptation, conservation and ecosystems: http://www.cuartacumbrecelac.com/home-eng/ http://www.celac2015.go.cr/category/cumbre/english-documents/ The 2015 summit produced a special declaration on climate change ahead of the Paris Agreements: http://www.celac2015.go.cr/special-declaration-6-of-the-community-of-latinamerican-and-caribbean-states-on-climate-change/ Moreover, the 2016 summit produced another special declaration named the " 2025 CELAC Plan

	group on Environment which holds meetings once a year.	on Food Security, Nutrition and Eradication of Hunger", which mentions Climate Change and environmental concerns: http://www.cuartacumbrecel ac.com/wp-content/uploads/2016/02/1. -Special-Declaration - 1-Food-Security.pdf
MERCOSUR	The MERCOSUR is a sub - regional bloc comprising Argentina, Brazil, Paraguay, Uruguay and Venezuela. It is the most consolidates of all regional blocks and has a large int ernational decision making structure similar to that of the EU. One of the principal cooperation themes is the environment and regular meetings between the environment ministers and regular meetings between the head of the DDR authorities are staged within the Council of the MERCOSUR. Moreover the MERCOSUR has a permanent regulatory Working Group on the environment that includes a d-hoc groups on biodiversity, environmental emergencies, air quality, waste management, regional environmental information system, fight against desertification amongst others.	MERCOSUR has adopted various resolutions regarding the environment seeking collaboration in themes related to conservation, biodiversity, natural disasters, and natural resource management which can be consulted in the following webpage : http://www.mercosur.int/innovaportal/v/5793/2/innova.front/documentacion -oficial -del-mercosur Moreover, a global project on sustainable development (mostly focused on sustainable consumption and production) is implemented with the EU: http://www.econormas - mercosur.net/es/objetivos
CAN	The CAN is a regional bloc comprised of Colombia, Bolivia, Peru and Ecuador formed in 1969. The principal objectives and strategic framework of the CAN mentions climate change, conservation, disaster risk reduction and biodiversity.	Numerous declarations and agreements on climate change, biodiversity, natural resource management, disaster risk reduction and have been signed through the CAN including a disaster risk reduction strategy, an integrated water basin management strategy, and a biodiversity strategy: http://www.comunidadandina.org/Index.aspx
Association of Caribbean States (ACS).	The ACS is a union of nations of the Caribbean Basin created in 1994. It was formed with the aim of promoting consultation, cooperation, and concerted action among all the countries of the Caribbean. The primary purpose of the ACS is to develop greater trade between the nations, enhance transportation, develop sustainable tourism, and facilitate greater and more e ffective responses to local natural disasters.	The ACS has a dedicated directorate on DRR which cooperates on the prevention and mitigation of risks. It has various projects on knowledge sharing and building regional capacity for disaster planning and reli ef (including master programs and pilot projects on various topics including climate change adaptation). http://www.acs -aec.org/index.php?q=disaster -risk-reduction

BolivarianAlliance for the Peoples of Our America (ALBA)	The ALBA is an intergovernmental organization based on the idea of the social, political and economic integration of the countries of Latin America and the Caribbean. It has 11 member states including: Ecuador , Venezuela, Bolivia, Nicaragua, and Cuba.	The ALBA cooperates on matters of socio economic development, culture and technology but does not have any clearly defined mechanism for CCAor DDR.

Source: prepared by Martín Calisto based on desk research.


Landscape in the San Martin region - Peru © Carolina Díaz.


Biosphere Reserve 'Nevados del Chillan – Laguna del Laja' Biological Corridor in the BíoBío Region in Chile © IUCN


"Ayuí Grande" Private Reserve, part of the Habitat Network of private nature reserves in Argentina © Ernesto Gamboa


Local researcher from Canchayllo - Nor Yauyos Cochas Landscape Reserve in Peru © Anelí Gómez

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