WORKING PAPER

Adopting nature-based solutions for flood risk reduction in Latin America

Working paper

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[July 2018]

Contents

Abreviations

CBD	Convention of Biological Diversity
CCA	Climate change adaptation
CEPREDENAC	Centre for the Prevention of Natural Disasters in Central America
CRID	Regional Centre for Disaster Information in Latin America and the Caribbean
DRR	Disaster risk reduction
EbA	Ecosystem-based Adaptation
IKI	International Climate Initiative
IUCN	International Union for Conservation of Nature
NbS	Nature-based solution
RAP	Regional Action Plan
SBSTTA	Subsidiary Body on Scientific, Technical and Technological Advice
SDGs	Sustainable Development Goals
SFDRR	Sendai Framework on Disaster Risk Reduction
UNISDR	United Nations Office for Disaster Risk Reduction
WWF	World Wildlife Foundation

WWF IUCN CEM ZURICH PRACTICAL ACTION Technology challenging poverty

Key messages:

- Nature-based solutions provide an opportunity to better integrate the agendas of climate action, disaster risk reduction and biodiversity conservation into a coherent and holistic approach.
- Ecosystems can provide benefits for flood risk reduction. Nature-based solutions should be part of broader disaster and climate risk management strategies, complementing other measures such as land use planning and built infrastructure.
- Building back safer and greener promotes resilience in future scenarios that face high levels of risk.
- Nature-based solutions can offer decentralised mechanisms that are managed by and for communities, and that require collaborative, participatory and multilevel governance across sectors and procedures.
- Local actors play a leading role in promoting and implementing nature-based solutions. Technical capacity building is critical to enable them to promote the approach.
- Improved scientific knowledge and effective communication on nature-based solutions has the potential to strengthen decision-making and mobilise resources for implementation.

This paper reflects the knowledge, experiences and lessons learned from the many experts who participated in the Latin America Regional Workshop entitled "Towards nature-based solutions: Green infrastructure for flood risk reduction", that took place between 11th and 12th of December 2017 in Lima, Peru. We are especially grateful for the valuable insights from: Cristina Rodríguez Valladares (Ministry of Environment, Peru), Jorge Suárez (Ministry of Economy and Finance, Peru), Juan Carlos Montero (CENEPRED, Peru), Fausto Asencio (Basin Committee Chira Piura, Peru), Daniel Iura González Terrazas (INECC, Mexico), Rogger Torres (Ministry of Environment, Bolivia), Michael Szoenyi (Zurich Insurance Company); Duminda Perera (UNU-INWEH, Canada), Alfredo Salinas (The Nature Conservancy, Peru), José Luis Alarcon (Global Water Partnership, Peru), Alcides Vilela (Practical Action, Peru), Margarita Céspedes (GIZ, Peru), Fiorella Miñan Barta (CARE, Peru), and Mariela Canepa (WWF, Peru).

Special thanks to Alicia Quezada, Emilie Etienne and Pedro Ferradas, Jacqueline Gotuzzo and David Lau (Practical Action, Peru) for their valuable contributions.

1. Background

Extreme weather events continue to cause significant damage, both in terms of lives lost, population displacement, livelihoods and assets destroyed. In most cases, climate change will increase the occurrence of natural hazard events at different scales and magnitude.[1] In the last five years (2012 – 2017) more than 135 million displacements of people are associated with disasters mostly by floods, storms and tropical cyclones.[2]

Thus making displacement by disasters more than two times as high as migration related to armed conflicts or violence. According to estimates from Swiss Re, in 2017 disasters caused economic losses of around $300 billion, which is considerably higher compared to 2016 ($178 billion).[3] Losses are expected to increase, unless disaster risk is reduced and managed properly. Future annual losses are estimated to be more than $ 300 billion each year.[4] Poor and marginalized populations are more often affected by disasters and suffer disproportionately. Specialists argue that these economic estimates do not accurately account for the overall impacts on livelihoods especially of most vulnerable populations.[5] In 2017, floods and landslides were most recurring extreme weather events, responsible for highest number of deaths and affected population.[6]

There are multiple types of floods of which most recurring are riverine (fluvial) floods, flash floods, coastal floods, storm surge and mudfloods. Latin America is one of the regions particularly exposed to a wide variety of natural hazards, where floods and landslides are by far the most recurring. Between 2017 and mid - 2018 alone, floods (also landslides and mudslides caused by heavy rains) across the region, resulted in considerable economic losses, claimed more than 700 lives and left more than 2.5 mil people affected.[7]

Environmental degradation is recognised as one of the factors that increases disaster risk, affecting exposure of societies to floods, landslides and other hazards.[8]

Type of flooding	Description
Riverine (fluvial) flooding	Results from water in a river or drainage channel that cannot be constrained within its stream channel or by constructed structures and inundates the floodplain. Often occurs seasonally. This is the most familiar type of flooding.
Flash flooding	Caused by intense rainfall over a period, ranging from minutes to hours, inundating creeks, streams and otherwise dry valleys.
Coastal flooding	Caused by increase in sea level due to storm surges generated by tropical cyclone winds and tsunamis.
Storm surge	Caused by convective storms, severe rains, earthquakes resulting in landslides. The causes of human incidence include changes in land use, urbanization. Increase in natural runoff.
Mudflood	Occurs when floodwater carries a heavy sediment load (i.e. mud, rocks, trees), and is often triggered by flash flooding or heavy rainfall flowing over nonporous geology with a soluble surface layer.

Source: Adapted from WWF (2016).

1 UNISDR, 2015. Making Development Sustainable: The Future of Disaster Risk Management. Global Assessment Report on Disaster Risk Reduction. Geneva, Switzerland: United Nations Office for Disaster Risk Reduction (UNISDR). Available at: https://www.preventionweb.net/english/hyogo/gar/2015/en/gar-pdf/GAR2015_EN.pdf

2 Internal displacement monitoring center, 2018. http://www.internal-displacement.org/database/displacement-data

3 Swiss Re Institute, 2017. News release. Available at: http://media.swissre.com/documents/nr20171220_sigma_estimates.pdf

4 UNISDR, 2015. Ibid.

5 The World Bank, 2017. Unbreakable: Building the Resilience of the Poor in the Face of Natural Disasters. Available at: https://openknowledge.worldbank.org/bitstream/handle/10986/25335/9781464810039.pdf?sequence=16&isAllowed=y

6 EM-DAT: The Emergency Events Database - Université catholique de Louvain (UCL) - CRED, D. Guha-Sapir - www.emdat.be, Brussels, Belgium. (Accessed on 5th May 2018).

7 EM-DAT. Ibid.

8 IPCC, 2012. Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation. A Special Report of Working Groups I and II of the Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge, UK, and New York, NY, USA. Available at: https://www.ipcc.ch/pdf/special-reports/srex/SREX_Full_Report.pdf

Policy makers can choose from a wide range of interventions to reduce disaster risk including policy frameworks, built infrastructure or/and solutions based on conserving, managing or restoring ecosystems. Among these options, infrastructure-based options have been by far the most common solution. However, there is an increased recognition of the role ecosystems play in providing critical services to reduce and mitigate risk of multiple types of flooding.[9]

Healthy ecosystems, including forests, wetlands, moors (*páramos* in Spanish) and punas (high mountain plateau characteristic of the Andes), can play a critical role in river basin management. Under certain conditions, ecosystems can help attenuate flows (by storing water in the system and releasing it gradually over time), thereby reducing the intensity and likelihood of destructive flood events. In the context of flood risks, ecosystems can act as natural infrastructure, mitigating disaster impacts by reducing physical vulnerability and strengthening resilience.

Taking a nature-based approach to flood risk reduction requires an improved understanding of the dynamics of the hydrological system and consideration of the upstream-downstream linkage of development activities and the risks they generate. Adopting such an approach is pivotal to address flood risk in an integrated manner that goes beyond administrative and sectoral boundaries. [10] This approach calls for collective action across multiple levels, stakeholders and sectors, with basins as the central unit of decision-making, and ideally for their governance as well.

Nature-based solutions to disaster risk reduction (DRR) and climate change adaptation (CCA) are a good strategy for the integrated management of land, water and biodiversity. They prioritise nature conservation and sustainable land use practices that can be implemented in harmony with more traditional methods. Under the Convention of Biological Diversity (CBD)[11] the central role of ecosystems and biodiversity to address DRR and CCA challenges is highlighted. Also known as ecosystem-based approaches, they are endorsed in major risk related agendas including the Sendai Framework on Disaster Risk Reduction (SFDRR)[12] , the Paris Agreement on Climate Change (COP21)[13] and the Sustainable Development Goals (SDGs).[14] Specifically, SFDRR mentions ecosystems as being vulnerable to natural and human activity induced hazard impacts, and therefore need to be adequately protected.

Practical Action Latin America (Soluciones Prácticas), as part of the Zurich Flood Resilience Program, sought to collect evidence of examples using nature-based solutions for flood risk reduction in Latin America and convenes a platform for regional knowledge exchange and learning. This working document is a collaborative effort between WWF, IUCN and Practical Action as a result of the Latin America Regional Workshop entitled "Towards nature-based solutions: Green infrastructure for flood risk reduction", that took place on 11-12 December 2017 in Lima, Peru.

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9 Nel, J. L., Le Maitre, D. C., Nel, D. C., Reyers, B., Archibald, S., van Wilgen, B. W., & Engelbrecht, F. A., 2014. Natural hazards in a changing world: a case for ecosystem- based management. PloS one, 9(5).

10 IPCC, 2014: Summary for policymakers. In: Climate Change 2014: Impacts, Adaptation, and Vulnerability. Part A: Global and Sectoral Aspects. Contribution of Working Group II to the Fifth Assessment Report of the Intergovernmental Panel on Climate Change. University Press, Cambridge, United Kingdom and New York, NY, USA, pp. 1-32. Available at: https://www.ipcc.ch/pdf/assessment-report/ar5/wg2/ar5_wgII_spm_en.pdf

11 Secretariat of the Convention on Biological Diversity (2009). Connecting Biodiversity and Climate Change Mitigation and Adaptation: Report of the Second Ad Hoc Technical Expert Group on Biodiversity and Climate Change. Montreal, Technical Series No. 41. Available at: https://www.cbd.int/doc/publications/cbd-ts-41-en.pdf

12 UNISDR, 2015. Sendai Framework for Disaster Risk Reduction 2015-2030. Available at: https://www.unisdr.org/files/43291_sendaiframeworkfordrren.pdf

13 UNFCCC, 2015. Paris Agreement of Climate Change. Available at: https://unfccc.int/sites/default/files/english_paris_agreement.pdf

14 UN, 2015. Sustainable Development Agenda 2030. Available at: https://www.un.org/sustainabledevelopment/sustainable-development-goals/

Photo 1: Los Polvorines, Piura, Perú. El Niño Costero 2017. Credits: Rodrigo Rodrich.

Based on the experiences presented at the workshop and the discussions held around them, this document provides key messages on the opportunities that nature-based solutions provide to address flood risk. It advocates for the need of adaptive governance as well as collaborative work to address flood-related challenges through responsible ecosystem management. In addition, the document seeks to facilitate knowledge generation and uptake at a regional scale to strengthen regional, national and local flood resilience.

2. Nature-based solutions for risk reduction in the context of floods: concepts and principles

There are two interrelated concepts when discussing nature-based solutions (NbS) for DRR – NbS as an umbrella concept, which underpins ecosystem-based disaster risk reduction (Eco-DRR), which specifically addresses DRR.

> **According to IUCN**, "Nature-based Solutions are (…) actions to protect, sustainably manage, and restore natural or modified ecosystems, that address societal challenges effectively and adaptively, simultaneously providing human well-being and biodiversity benefits"[15]

15 Cohen-Shacham E, Walters G, Janzen C, Maginnis S., 2016. Nature-based solutions to address societal challenges. IUCN, Gland.

> **According to the Partnership on Environment and Disaster Risk Reduction (PEDRR)**, "Ecosystem-based disaster risk reduction is the sustainable management, conservation and restoration of ecosystems to reduce disaster risk, with the aim of achieving sustainable and resilient development"[16]

Cohen-Sacham et al. (2016) considers Eco-DRR as sub-component of NbS together with other concepts such as Ecosystem-based Adaptation. International Union for Conservation of Nature (IUCN) suggests that NbS actions should follow **8 principles**.[17] Eco-RRD have **7 core elements**, which overlap partially with the principles for NbS.[18]

Principles of nature-based solutions	Core elements of Eco-DRR
1. Embrace nature conservation norms (and principles);	1. Recognises the multiple functions and services provided by ecosystems, including natural hazard protection or mitigation;
2. Can be implemented alone or in an integrated manner with other solutions to societal challenges (e.g. technological and engineering solutions);	2. Links ecosystems-based risk reduction with sustainable livelihoods and development;
3. Are determined by site-specific natural and cultural contexts that include traditional, local and scientific knowledge;	3. Combines investments in ecosystems with other effective DRR strategies, including hard engineering options;
4. Produce societal benefits in a fair and equitable way, in a manner that promotes transparency and broad participation;	4. Addresses risks associated with climate change and extreme events and reduces their impact on ecosystem services;
5. Maintain biological and cultural diversity and the ability of ecosystems to evolve over time;	5. Enhances governance capacities for ecosystem-based DRR through multi-sector, multi-disciplinary platforms;
6. Are applied at a landscape scale;	6. Involves local stakeholders in decision-making;
7. Recognise and address the trade-offs between the production of a few immediate economic benefits for development, and future options to produce the full range of ecosystems services;	7. Utilises existing instruments and tools in ecosystems management and enhances their DRR value.
8. Are an integral part of the overall design of policies, and measures or actions, to address specific challenges.	

Available at: https://portals.iucn.org/library/sites/library/files/documents/2016-036.pdf

16 Estrella, M. and N. Saalismaa. 2013. Ecosystem-based Disaster Risk Reduction (Eco-DRR): An Overview, In: Renaud, F., Sudmeier-Rieux, K. and M. Estrella (eds.) The role of ecosystem management in disaster risk reduction. Tokyo: UNU Press.

17 Cohen-Shacham E, Walters G, Janzen C, Maginnis S., 2016. Nature-based solutions to address societal challenges. IUCN, Gland. Available at: https://portals.iucn.org/library/sites/library/files/documents/2016-036.pdf

18 PEDRR, 2010. Demonstrating the Role of Ecosystems-based Management for Disaster Risk Reduction. Partnership for Environment and Disaster Risk Reduction. Available at: https://www.unisdr.org/we/inform/publications/49669

The field of ecosystem-based approaches for DRR and CCA has developed rapidly during the past decade. Moreover, the Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) of the CBD has discussed and adopted the voluntary guidelines for the design and effective implementation of ecosystem- based approaches to climate change adaptation and disaster risk reduction (CBD/SBSTTA/22/8).[19] Currently, there are multiple efforts to refine these concepts and provide specific guidelines and criteria for on-the-ground implementation with particular relevance to flooding. Recent important advances on NbS for flood risk reduction include the publications from the World Bank (2017) on Implementing Nature-based Flood Protection[20] and WWF (2016) on Guidelines on natural and nature-based flood management: a Green Guide.[21] ABoth publications outline principles and provide guidelines to promote best practices and prevent common faults.

There is a wide range of flood risk management solutions including non-structural (e.g. policies and early warning systems) and structural in the form of nature-based (soft) solutions (e.g. wetland restoration and natural drainage path recovery) and grey (hard) solutions (e.g. dams and reservoirs). To effectively reduce flood risk it is recommended first to apply non-structural solutions and then consider structural solutions by prioritising NbS whenever possible as part of an integrated approach. NbS can be combined with grey solutions referring as well to hybrid solutions (e.g. dikes with ecosystem restoration). In the case of no other options, then grey solutions can be selected.

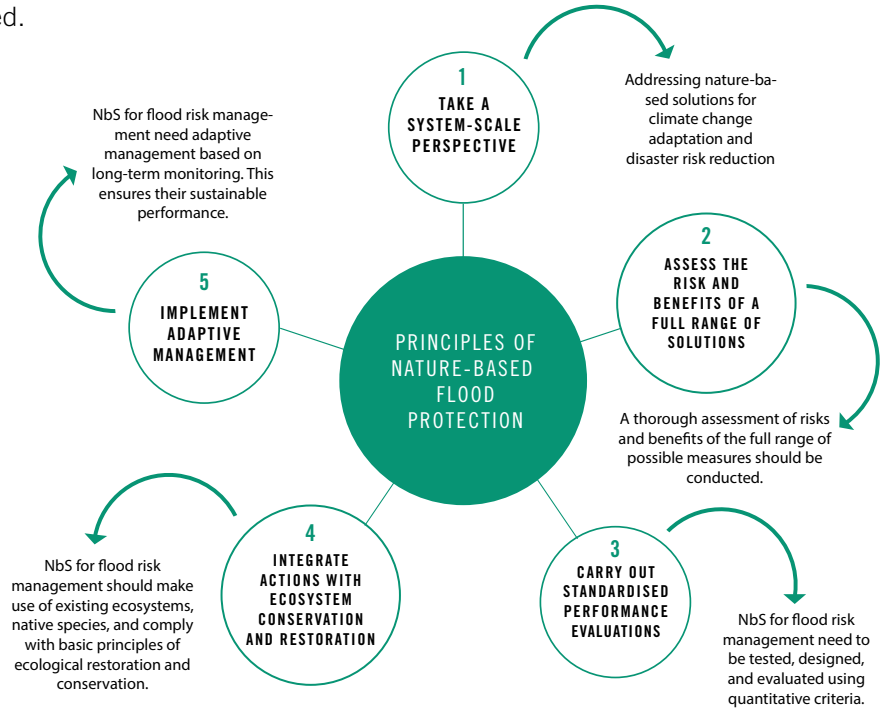

Fig. 1. Principles of Nature-based Flood Protection. Source: Adapted from the World Bank (2017).

19 CBD, 2018. Voluntary guidelines for the design and effective implementation of ecosystem-based approaches to climate change adaptation and disaster risk reduction. Summary available at: https://www.cbd.int/doc/c/992f/b4bb/09059fef526c32991fe36c54/sbstta-22-crp-07-en.pdf

20 The World Bank, 2017. Implementing nature based flood protection: principles and implementation guidance . Washington, D.C.: World Bank Group. Available at: http://documents.worldbank.org/curated/en/739421509427698706/Implementing-nature-based-flood-protection-principles-and-implementation-guidance

21 World Wildlife Fund 2016. Natural & Nature-based Flood Management: a Green Guide. Washingtond D.C. Available at: http://envirodm.org/flood-management

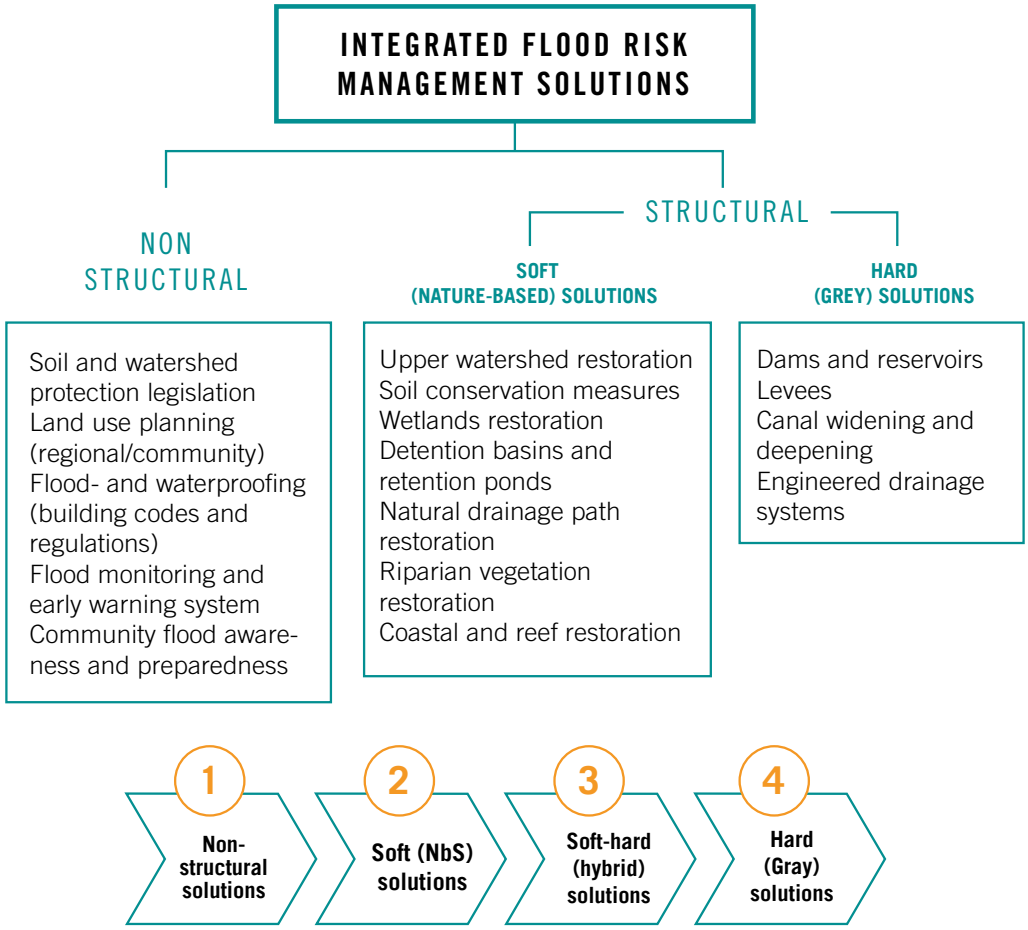

Fig.2. Structural and non-structural flood risk management solutions and implementation steps. Source: Adapted from World Bank (2017) and WWF (2016).

3. Overview of flood risk management in Latin America

The Latin American region is highly exposed to a wide range of natural hazards including storms, earthquakes, volcanic activity, floods, and droughts.[22] Hydro-meteorological events associated with rain patterns or extreme events provoked by the El Niño Southern Oscillation (ENSO) are characteristic for the region and generate either frequent floods accompanied by landslides or droughts. Severe floods and droughts associated with extraordinary strong ENSO ravaged many countries in 1982 -1983, 1997 – 1998 and 2016 - 2017. Of all disasters, floods are by far the most frequent one in Latin America, taking the most significant share (55%) in the past 15 years (2002 - 2017).[23] It is reported that floods caused an estimated US$ 19 billion affecting more than 27 million people and claiming more than 6 000 lives.[24]

Occurrence of disasters by type in Latin America

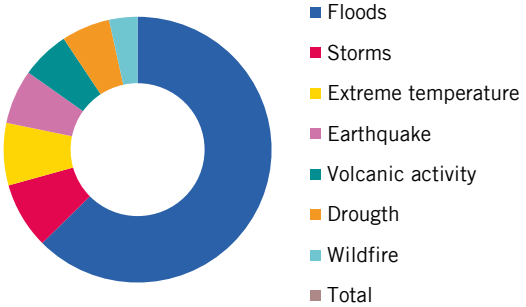

Fig.3. Proportion of disasters by type in Latin America 2002 - 2017. Source: Own elaboration based on EM-DAT (2018).

22 IPCC, 2014. Ibid
23 EM-DAT. Ibid.
24 EM-DAT. Ibid.

Climate scenarios project with medium confidence an increase in the frequency of heavy precipitation especially in the high latitudes and tropical regions.[25] The countries that rank highest in the INFORM risk index (2018) with regards to flood exposure, vulnerability and capacities to respond include Bolivia, Colombia, Guatemala, Honduras, Mexico and Nicaragua.[26]

Summary of predicted climate change trends for Latin America in 21st century.[27]

- Water availability will be affected in semi-arid and glacier-melt-dependent regions and Central America (high confidence).
- Increase in the frequency of heavy precipitation or the proportion of total rainfall from heavy falls, especially in the high latitudes and tropical regions (medium confidence).
- Droughts will intensify in some seasons and areas, due to reduced precipitation and/or increased evapotranspiration in Central America and Mexico, and northeast Brazil (medium confidence).
- Sea level rise will contribute to upward trends in extreme coastal high water levels (medium confidence).

Environmental degradation, poor land-use planning and climate change in part condition the level of flood risk in each country. This combination generates high levels of physical vulnerability, especially in un-planned urbanization (e.g. peri-urban) areas, increasing their susceptibility to flooding and landslides.

Habitat loss and land degradation continues to be one of the greatest challenges in the region. Deforestation, in the Amazon and in other forest ecosystems, and loss of grasslands and fragile mountain biomes are examples of these processes.[28] Another factor for increased risk is the limited capacity of institutions to cope with floods, particularly at the sub-national levels. This is to an extent because of a lack of mechanisms for inter-institutional and sectoral coordination as well as limited human and financial resources for risk management. There is also a dependence on emergency preparedness, rehabilitation and recovery, rather than prioritizing ex-ante risk reduction in development planning.

National governments in the region have long recognised the necessity to address disaster risk. Important advances have taken place in terms of knowledge gathering, information systems and local actions. A key regional achievement is the adoption of a disaster risk reduction approach that includes:[29]

1. Detailed analysis of the records of local disasters including events smaller than those reported in the databases of international organisations;
2. Recognition of the central role played by local governments in disaster risk reduction, supported by national and local civil defence units working with civil society and with the people who live at risk.

In addition, regional collaboration has been established on the generation and exchange of information, such as the Regional Disaster Information Center in Latin America and the Caribbean (CRID). In addition, an official sub-regional coordination mechanism has been created, which in turn has as one of its axes the promotion of information among the countries - Coordination Center for the Prevention of Natural Disasters

25 IPCC, 2014. Ibid.
26 INFORM, 2018. Index for risk management for Latin America and the Caribbean LAC-Inform 2018 Update. Available at: http://www.inform-index.org/Portals/0/InfoRM/2018/Subnational/LAC_INFORM_2018_v005_MainResults_Eng.pdf?ver=2018-03-09-082636-400
27 IPCC, 2014. Ibid.
28 UNEP 2016. GEO-6 Regional Assessment for Latin America and the Caribbean. United Nations Environment Programme, Nairobi, Kenya. Available at: http://wedocs.unep.org/bitstream/handle/20.500.11822/7659/GEO_LAC_201611.pdf?sequence=1&isAllowed=y
29 Aragon, F., 2014. Inundaciones en zonas urbanas de cuencas en América Latina (Flooding in urban basin areas in Latin America). Lima: Soluciones Prácticas; 2014. Available at: https://solucionespracticas.org.pe/Inundaciones-en-zonas-urbanas-de-cuencas-en-America-Latina

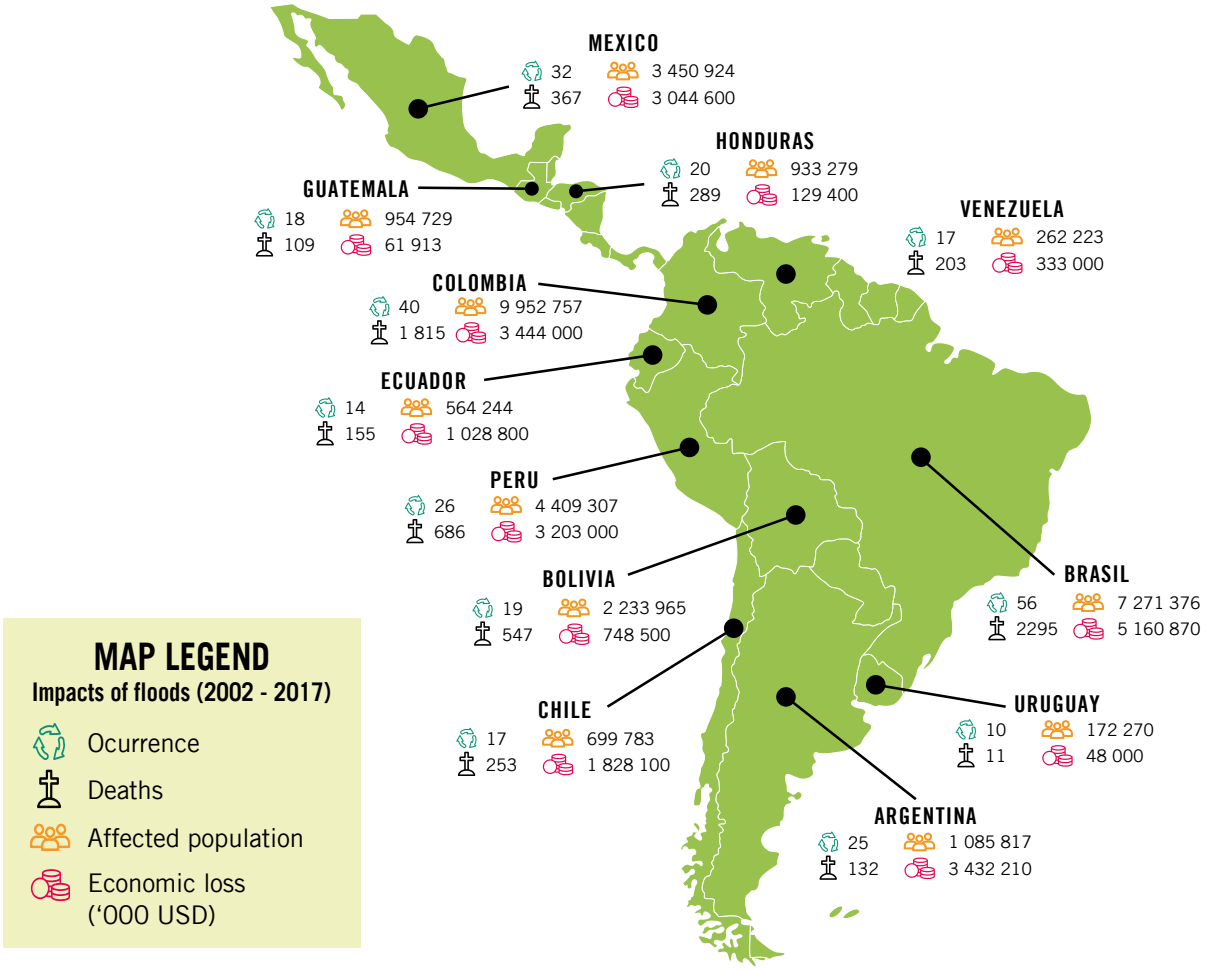

Fig. 4: Impacts of floods in selected countries in Latin America for the period 2002 - 2017. Source: Own elaboration based on EM-DAT (2018).

in Central America and the Caribbean (CEPREDENAC). The Regional Platform for Disaster Risk Reduction in the Americas plays a key role in advancing the implementation of the Sendai Framework.

In the Asuncion Declaration (2016) the countries state that in order to advance in eradicating poverty, reducing inequality and achieving sustainable and inclusive development, it is pivotal to address disaster risk by implementing effective policies at all territorial and sectoral levels.[30] As parties to the Sendai Framework for Disaster Risk Reduction, in 2017 the countries in the region agreed on a Regional Action Plan (RAP) for the Implementation of the Sendai Framework for Disaster Risk Reduction 2015 – 2030 in the Americas.[31] This marks a milestone towards a joint regional approach in the efforts to build community resilience and reduce disaster risk and impacts. The RAP helps further the implementation of the Sendai Framework in the Americas through the identification of regional initiatives that contribute to one or more of the Sendai Actions. Although ecosystem conservation is not explicitly mentioned as an action in the RAP, it highlights the need to better understand disaster risks posed to the environment and invest in DRR for resilience of ecosystems among other actions.

30 UNISDR, 2016. Asuncion Declaration "Guidelines towards a Regional Action Plan for the Implementation of the Sendai Framework 2015 - 2030". Available at: https://www.preventionweb.net/files/49235_asunciondeclaration2016.pdf

31 UNISDR, 2017. Regional Action Plan for the Implementation of the Sendai Framework for Disaster Risk Reduction 2015 – 2030 in the Americas. Available at: http://eird.org/rp17/regional-action-plan-english-rp17.pdf

While these efforts are undeniably important, disaster management strategies in the region often prioritise costly and engineered infrastructure solutions overlooking the potential of ecosystems for addressing climate risks. Experiences show that such engineered solutions result in isolated attempts at risk reduction that inadvertently can transfer risk to more vulnerable areas, or, in case of flood hazards, downstream. Such conventional risk management approaches focus on addressing single sources of hazards and neglect the complex, cascading features of flooding. It is therefore vital for the countries in the region to take NbS approach as cost-effective alternative to reduce vulnerabilities and risks to disasters.

4. From science to practice: tools and guidelines to inform policy-making in Latin America

Nature-based solutions are increasingly recognised and adopted as part of disaster risk reduction strategies.[32] Por lo tanto, Therefore, trustworthy and accessible information is vital for decision-making. While there is already substantial empirical evidence that such solutions work in many contexts, there remain knowledge gaps, which require attention to better inform policy and practice.[33] A better understanding is required for instance on how ecosystem-approaches for DRR operate at different spatial and temporal scales, as well, what are their limits under different circumstances and situations. Moreover, there is a need for clear evidence on what environmental and social factors may condition the effectiveness of nature-based solutions to reduce flood risks. At the heart of challenges to adopting such solutions is often the limited or lack of institutional and human capacities to integrate ecosystem-based DRR in plans, programs, and projects.

To guide this process, evidence-based information, tools, and guidelines are essential to support decision-making for comprehensive planning and programming for ecosystem-based DRR. There is an increasing number of tools and guidelines that include ecosystems in their equations and have made advances in decisions regarding ecosystem-based DRR[34]. Herein we present some case studies of applications of tools and guidelines in Latin America that advance risk assessments and implementation of ecosystem-based solutions.

32 Sudmeier-Rieux, K., & Ash, N. 2009. Environmental guidance note for disaster risk reduction: healthy ecosystems for human security. IUCN.

33 Renaud, F., Sudmeier-Rieux,K., Estrella,M., Nehren, U. 2016. Ecosystem-Based Disaster Risk Reduction and Adaptation in Practice (Vol. 42). http://doi.org/10.1007/978-3-319-43633-3

34 Whelchel, A.W. and M.W. Beck, 2016. Decision Tools and Approaches to Advance Ecosystem-Based Disaster Risk Reduction and Climate Change Adaptation in the Twenty-First Century In: Renaud, F., Sudmeier-Rieux, K., Estrella, M. and U. Nehren (eds.) Ecosystem-Based Disaster Risk Reduction and Adaptation in Practice (Vol. 42). http://doi.org/10.1007/978-3-319-43633-3

Resilience through Investing in Ecosystems - knowledge, innovation and transformation of risk management (Kit RELIEF)

The RELIEF Kit was an initiative (2015 – 2017) financed by Japan's Biodiversity Fund under the CBD that aimed to document linkages between biodiversity and disasters. It establishes capacity development knowledge products for policy makers, researchers and other relevant stakeholders. RELIEF Kit sought to address knowledge gaps and capacity needs by documenting and analysing evidence. The initiative also facilitates regional knowledge exchange platforms. To address worldwide knowledge gaps on Eco-DRR, six regional assessments have been conducted. In South America, the assessment focused on six countries: Argentina, Bolivia, Chile, Colombia, Ecuador and Peru. RELIEF Kit shows that compilation, analysis and systematisation of scientific information and local or traditional knowledge is needed to demonstrate the multiple benefits of nature-based solutions (including Eco-DRR and EbA). This is crucial for an adequate and integrated disaster risk management, and also to inform policy-making processes.

For more information: RELIEF Kit
Relevant publications:
Helping nature help us: Transforming disaster risk reduction through ecosystem management
Regional Assessment on Ecosystem-based Disaster Risk Reduction and Biodiversity in South America

Green Recovery and Reconstruction Toolbox: Latin American experience

The Green Recovery and Reconstruction Toolbox (GRRT) was developed by the World Wildlife Fund (WWF), and the American Red Cross after the 2004 tsunami in the Indian Ocean. It was designed to be used anywhere in the world after a natural hazard event. Although disasters wreak havoc, the rebuilding efforts that follow represent a significant and important opportunity to restore communities in a more environmentally and socially sustainable way. Humanitarians, conservation practitioners, government officials, local communities, and donor organizations can take steps to ensure reconstructed communities are built back safer through actively addressing environmental sustainability, reducing risk and vulnerability to future disasters, and adapting to the realities of our changing climate.

The GRRT contributes to making communities more resilient, by incorporating environmental aspects into the recovery process as an integral part. It also contributes to planning and development of projects in the face of any extreme climate event such as floods. The toolkit includes ten modules:

1. Opportunities after Disasters: Introduction to Green Recovery and Reconstruction
2. Project Design, Monitoring and Evaluation
3. Environmental Impact Assessment Tools and Techniques
4. Strategic Site Selection and Development
5. Materials and the Supply Chain
6. Construction
7. Water and Sanitation
8. Livelihoods
9. Disaster Risk Reduction
10. Organisational Operations

The Toolbox was translated into Spanish by WWF Guatemala and has served to strengthen capacities in different Latin American countries (Guatemala, Honduras, Ecuador, and Colombia). A Training of Trainers (ToT) process took place in the western highlands of Guatemala to facilitate the dissemination of GRRT across these countries. The implementation of ToT demonstrated that capacity building must take place at all levels to ensure that actions are undertaken by the different actors involved.

Source: World Wildlife Fund (WWF) Guatemala/Mesoamerica

For more information: Green Recovery and Reconstruction Toolkit (English) Recuperación y Reconstrucción Verde: Caja de Herramientas de Capacitación para la Ayuda Humanitaria (Spanish)

Photo 2: Use of the GRRT Toolbox in Guatemala. Credits: WWF - Guatemala.

Ecosystems for the Protection of Infrastructure and Communities (EPIC)

EPIC was a global project implemented by IUCN (2012 – 2017) part of the International Climate Initiative (IKI) financed by Germany's Federal Ministry for the Environment, Nature Conservation and Building (BMU) to promote the use of ecosystem-based approaches, and protect communities from disasters and the negative impacts of climate change. The EPIC project site in Chile was the biosphere reserve Corredor Biológico Nevados de Chillán-Laguna del Laja (Biological Corridor of the Snowed Mountains of Chillan- Laja Lagoon, referred as BR), that seeks to reconcile the conservation of biological and cultural diversity with economic and social development. The area has eight communes with a total population of around 7,728 inhabitants. Around 78% of the BR is owned privately.

The study site called Valle de las Trancas is exposed to a variety of natural hazards including avalanches and debris flows. Using rigorous, pioneering science and multi-stakeholder dialogues, EPIC was able to position the Eco-DRR approach among a diverse range of stakeholders from local to national levels. Using evidence-based knowledge and science, the project also increased awareness within communities on the protective role of forests. The main findings and recommendations include:

- The engagement of a diversity of stakeholders at both local and national levels to promote inter-institutional and multi-disciplinary coordination is useful for maximising impacts at policy levels.
- When disseminating scientific knowledge it should be tailored in a way that is accessible to stakeholders — e.g. decision-makers, civil society, and academics.
- There is a need to ensure that Eco-DRR and EbA are institutionalised to obtain enduring influence, for this more multi-level spaces for cross learning are needed to integrate perspectives and maximise impacts in policy at all levels.
- Land-use planning in Chile is a sector that must be focused on, from a multi- sectorial and territorial perspective, for the integration of Eco-DRR into the country's planning and policy.

Source: International Union for Conservation of Nature (IUCN)
For more information: Ecosystems protecting infrastructure and communities: Lessons learned and guidelines for implementation

The Flood Resilience Measurement Tool

The aim of the Zurich Flood Resilience Alliance, a multi-year initiative, is to advance knowledge, develop expertise, and design strategies to help communities improve their ability to deal with recurring floods. The Alliance seeks to strengthen flood resilience by enabling communities to understand their potential sources of resilience. To do this, it has established a framework that can meet the challenge of measuring resilience, and also does it in an empirically verifiable way. The tool also adopts a systems thinking approach, which takes into account the assets, interactions and interconnections at the community level, and provides consistency when it comes to identifying and testing potential sources of resilience.

The Flood Resilience Measurement Tool (FRMT) combined two existing models: the 5Cs16 and the 4Rs17 models. The 5Cs model developed as part of DFID's sustainable livelihoods framework, refers to complementary capitals that can help people on their development path, while also providing capacity to withstand and respond to shocks. The 5Cs are human, social, physical, financial and natural capitals. On the other hand, the 4Rs model refers to four properties of a resilient system, developed by MCEER: robustness (ability to withstand a shock); redundancy (functional diversity); resourcefulness (ability to mobilise when threatened); and rapidity (ability to contain losses and recover in a timely manner). The framework uses indicators referred to "88 Sources of Resilience" based on these models.

The FRMT identifies natural capital as a significant source of resilience, as it can provide a cost-efficient flood risk reduction solution that can be managed using local knowledge and capacities. Natural capital in the FRMT has 6 sources: river basin health, habitat connectivity, natural habitats maintained for flood resilience services, sustainable use of natural resources, conservation management plan, and national legislation that recognises habitat restoration. Practical Action, one of the alliance members, has tested the FRMT by engaging with communities in the Piura and Rimac river basins in Peru, and also the Karnali river basin in Nepal. Additionally, by working with partners the tool has been piloted in over 100 communities so far.

Source: Zurich Flood Resilience Program
For more information: Measuring resilience: a better way to help communities threatened by floods

Photo 3: Implementation of the FRMT tool in Piura, Peru. Credits: Rodrigo Rodrich.

Natural and Nature-based Flood Management: A Green Guide (Flood Green Guide)

The World Wildlife Fund´s (WWF) Flood Green Guide was developed in partnership with USAID´s Office of US Foreign Disaster Assistance (OFDA). The guide introduces an integrated framework for flood management, drawing on policy, green infrastructure, and conventional engineering to help communities adapt and better manage growing flood risk. The guide is especially designed for those responsible for the management of flood risk, including municipal governments, community groups, and non-governmental organisations. The Flood Green Guide supports local communities' flood management efforts using an integrated watershed approach. The guide promotes environmental and social co-benefits, and provides guidance on an optimal combination of approaches including: non-structural policies, natural and nature-based methods, and where necessary, hard engineering to manage flood risk.

Flood risk managers should include disaster risk reduction and adaptation to a changing climate in their management strategies. In urban areas there may be fewer options for flood risk management; but, whenever possible, flood managers should work to engage with basin-wide planning. Finally, flood disaster recovery efforts should improve community resilience to future extreme events. They should also avoid introducing new social or environmental vulnerabilities, and enhance community capacity to adapt to changing conditions, including extreme climate-related events.

Source: World Wildlife Fund (WWF)
For more information: Natural and Nature-Based Flood Management: A Green Guide

5. From governance to practice: experiences from Latin America

New forms of governance that encourage multi-level and collaborative models is essential for nature-based strategies to address DRR. Given the nature of climate change and disaster risks and even more ecosystems, mandates and responsibilities of government actors often overlap and government models need to be inclusive and adaptive. Institutions at all levels have roles and remits in decision-making relating to flood risk management, strong coordination among them at national, provincial, district and local levels is therefore critical.

Local actors (e.g. municipalities and local communities) play a leading role in promoting and implementing nature-based measures for flood risk reduction, guided by their good knowledge on the factors shaping the vulnerability of the local population and ecosystems. As the example of Mocoa (Colombia) demonstrates, both the engagement and leadership of municipalities is key to effective and sustainable implementation of green solutions. River Basin Organisations (RBOs) are another actor relevant to flood risk reduction. The formation of RBOs can enable the coordination of development activities and engagement with diverse stakeholders at a basin scale. The experience of Chira-Piura River Basin Council (Peru) highlights the need to foster multi-stakeholder dialogues at basin-scale for the integration of nature-based solutions to risk reduction and adaptation in basin planning.

Integrated approach for vulnerability reduction to flood risk in the basin Chira-Piura, Peru

The department of Piura, in Northern Peru, is one of the regions worst affected by floods15 (especially during the El Niño phenomenon). Piura is straddled by two major rivers: Chira and Piura. Critical factors underpinning the vulnerability of the area include: an insufficient drainage system, inadequate land planning resulting in the expansion of settlements in risk-prone areas along riverbeds, and increased erosion and sedimentation originating from degradation of the upper part of the basin. A structured and highly participatory process (in 2011) led to the creation of the Chira-Piura River Basin Council and the development of a River Basin Management Plan. The River Basin Council is now a leading actor in basin-scale governance, it enables the coordination of development activities by engaging with diverse stakeholders at the basin scale. The elaborated River Basin Management Plan takes a proactive disaster risk reduction approach, recognizing that managing risk at the basin scale is the key to an integrated and long-term vision for resilience building. The plan acknowledges that deforestation and land degradation in the upper basin affect the hydrological regime and increase the risk of flood in the lower part of the basin. To reverse these trends the plan promotes actions for reforestation, forest protection, and sustainable soil management to reduce erosion and land degradation.

Source: Chira-Piura River Basin Council

Photo 4: Hydrographic Basin Chira-Piura, Peru. Credits: Rodrigo Rodrich.

Environmental initiative for green recovery & reconstruction of Mocoa, Colombia

Mocoa is a municipality of 40,000 people in Colombia, in the region of the Northern –Amazon. On March 31, 2017, a massive landslide destroys about 10% of Mocoa´s urban areas. This led to a big social, economic and environmental disaster, with hundreds of people killed and others displaced due to the large destruction of infrastructure (roads, houses, utilities, etc.) After the end of the humanitarian response (which lasted approximately one month) the Environmental Initiative for the Reconstruction of Mocoa - EIRM (Mesa Ambiental para la Reconstrucción de Mocoa, in Spanish) was established. The EIRM is a self-organised cluster of local authorities, NGOs, universities and other organisations, and co-lead by the regional environmental institution-CORPOAMAZONIA and WWF to support effective and sustainable reconstruction.

The EIRM started to coordinate the environmental agenda for the reconstruction of Mocoa. It focused in two main aspects: integrating environmental standards and strengthening the role of the environmental authorities in the on-going recovery actions; and supporting the participatory development of the long-term vision of the reconstruction of the city, as well as the inclusion of environmental and sustainability principles on it. The key challenge for the EIRM is Mocoa´s new Land Use Plan (LUP). According to Colombia´s regulation, the LUP is the main long-term policy instrument that each municipality has to plan and regulate for the use of both urban and rural land. This integration, by law, needs to explicitly acknowledge the importance of places with exceptional value for biodiversity, conservation, water regulation, and for disaster risk reduction. Therefore, significant efforts are being undertaken by the EIRM to highlight the importance of:

- Updating the portfolio of locally protected areas, with the possibility of expanding existing ones, and declaring new ones.
- Identifying places with natural coverage that have critical importance for water regulation and /or flood management.
- Working with urban planners to identify options to limit the urban footprint of the city.
- Participatory development of options for green infrastructure, especially for disaster risk reduction and climate change adaptation

Source: World Wildlife Foundation (WWF) - Colombia

Photo 5: Pepino river, Putumayo, Colombia. Credits: David Fajardo / WWF-Colombia

6. Challenges and opportunities for integrating nature – based solutions in DRR in Latin America

Significant progress in disaster risk management and ecosystem governance has already been achieved in Latin America. However, adopting nature-based solutions for DRR presents certain challenges in regards to institutional arrangements, political frameworks, and capacities (individual and institutional) as well as availability and access to information. Addressing such challenges, as well as creating an enabling environment is vital for adopting nature-based solutions for flood risk reduction in development planning. Key opportunities and challenges were discussed at the regional workshop and are highlighted in Figure 2.

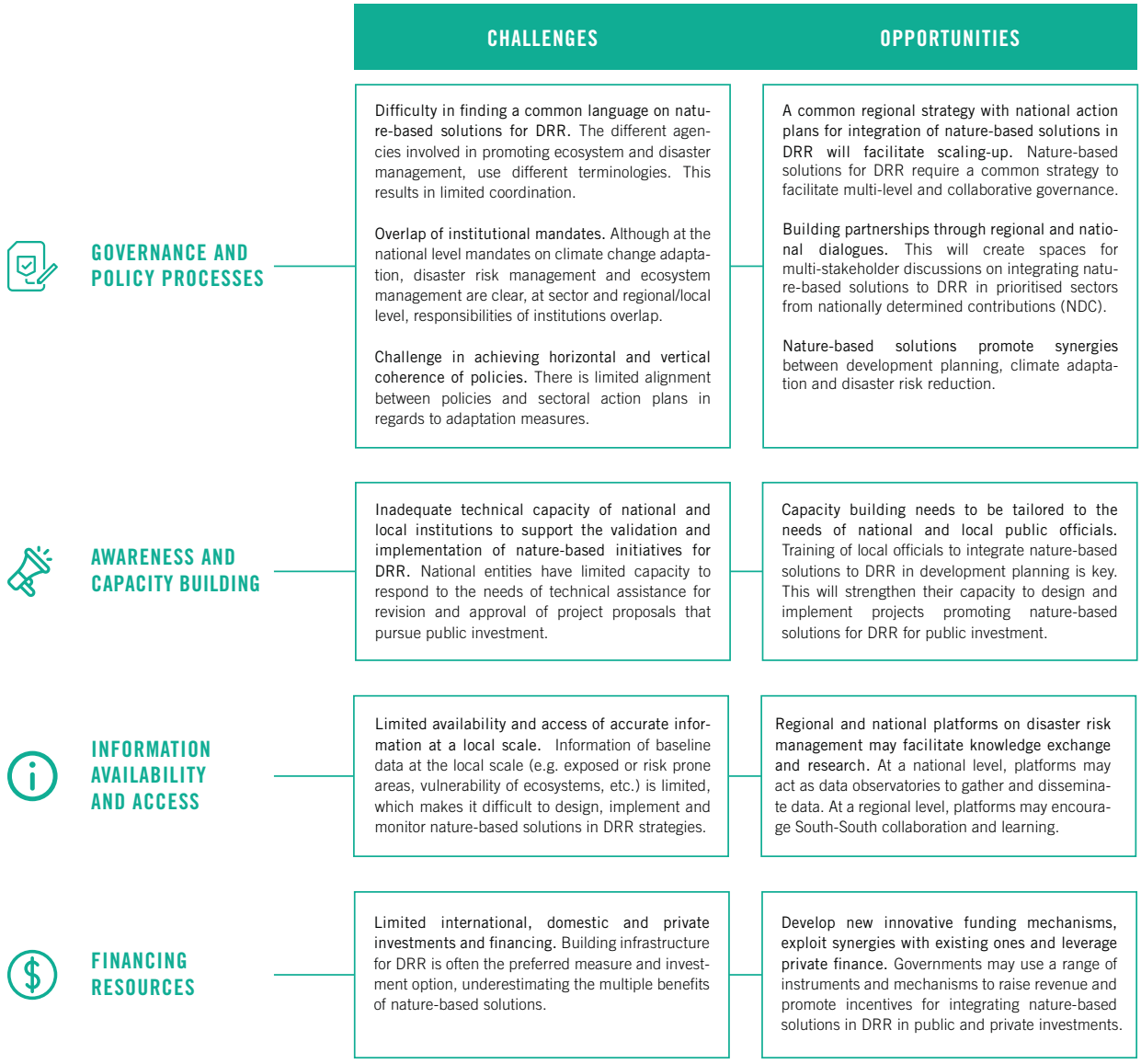

Fig.5 Key challenges and opportunities for adopting nature-based solutions to DRR in Latin America.

7. Key messages and recommendations

A common strategy for Latin American countries would contribute to making ecosystems an essential component in flood risk reduction efforts. There is existing and growing evidence in the region of successful cases in which nature-based solutions for DRR have been adopted. Yet many of these initiatives are stand-alone projects. If a coordinated and common strategy is considered, it will strengthen the adoption of the approach at a national and regional scale. The regional workshop "Towards nature-based solutions: Green infrastructure for flood risk reduction" provided a space for the identification of important aspects that should be considered to progress in the goal of developing a common agenda that includes aspects of governance, science and practice. These are:

- Ecosystems provide benefits for flood risk reduction. Nature-based solutions should be part of broader disaster and climate risk management strategies, complementing other measures, such as land use planning and built infrastructure. Healthy ecosystems play two critical roles in river basin/water management. First, they can help attenuate flows, thus reducing the intensity and likelihood of destructive flood events; and second they can maintain flows during dry seasons, ensuring river flows are more stable across seasons. Ecosystem-based approaches are not a substitute for engineered solutions but are complementary and work well in conjunction with engineered river/flood management approaches. Healthy ecosystems can increase the value of engineered solutions and enhance their ability to manage flood risk in large basins.

- Nature-based solutions provide an opportunity to better integrate the agendas of climate change adaptation and disaster risk reduction. Climate change adaptation and disaster risk reduction are interrelated in many ways, and the issue of coordination, integration, and synergies between both approaches has been at the forefront of international discussions in recent years. Countries from Latin America have worked for many years

Photo 6: Regional workshop "Towards solutions based on nature: Green infrastructure for flood risk reduction", Lima, Peru. Credits: Giorgio Madueño.

to mainstream disaster risk management in their national climate change strategies. However, in practice, it is evident that coordinated governance across both approaches is made difficult by using different conceptual frameworks, despite it being recognised that ecosystems and the services they provide are central to both disaster risk reduction and climate change adaptation.

- Building back safer and greener promotes resilience in future high-risk scenarios. Floods and landslides are drivers of impacts, but they also provide a window of opportunity to be more successful in reducing disaster risk, and can also facilitate changes in policy, institutions, and society general. Disaster prevention interventions that aim at promoting resilience through ecosystem management play a vital role in these objectives. Principles for building back safer and greener in recovery, rehabilitation and reconstruction provide key entry points for integrating nature-based approaches. Restoration of riverbanks and riverine flood control through natural infrastructure (e.g. flood bypasses, riparian buffers, wetland construction, etc.), combined with improved land-use planning, present an opportunity to ensure that recovery activities are adequately considering the role of ecosystems in disaster risk reduction.

- Nature-based solutions require collaborative, participatory, multilevel and multi stakeholder governance across sectors and procedures. Due to the complexity of flood events, many institutions work on risk management actions, which often results in an overlap of institutional mandates. Many of the countries in Latin America have comprehensive institutional frameworks, as well as national level mandates on disaster risk management and ecosystem management that are clear. However, responsibilities of institutions overlap at the sectoral, regional and local level. Experiences show that policy processes for promoting nature-based solutions for flood risk reduction occur through multi-level and collaborative governance. It is therefore necessary to promote the transfer of new concepts among all actors by facilitating meetings and multi-sectoral workshops at multiple governance levels.

Photo 7: Defenses in Piura, Peru. Credits: Rodrigo Rodrich.

- Local actors play a leading role in promoting and implementing nature-based solutions. Technical capacity building is critical to strengthen their engagement. As demonstrated at the workshop, local actors (e.g. municipalities, local businesses, individual landowners, communities, and indigenous associations) can play a leading role in promoting and implementing nature-based measures for DRR. They often have excellent knowledge of the factors that shape the vulnerability of the local population and ecosystems. Nonetheless, their capacity is often constrained by their weak technical knowledge and limited resources. Continued and specialised capacity strengthening of local officials and community representatives, especially on accessing national and international financial mechanisms, should be considered.

- Improved scientific knowledge and effective communication on nature-based solutions has the potential to strengthen decision-making and mobilise resources for implementation. Informed decision-making requires robust information and good understanding of the linkages between ecosystems and disaster risk management practices. The access and effective communication of such information is needed to increase awareness and interest; and to promote the allocation of resources. This is especially true for improving mainstreaming nature-based approaches through rising inter-and intra-organisational cooperation and participation in developing sectoral plans and disaster risk management projects.


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