WATER AND THE ENVIRONMENT

8th World Water Forum
Results and Discussions
Volume 1

Adasa

The information contained in this publication is the result of quantitative and qualitative analyses of the documents generated during the sessions held at the 8th World Water Forum and was generated through means of sampling all available material using a method developed to systematize the research under the theme *"Water and the Environment"*.

The authors of this volume hereby declare that the content presented solely and exclusively reflects the analyses and opinions developed with support from the teams involved, the literature cited, and an analysis of the material available and therefore they do not represent any view or position taken by Adasa with regards to the themes addressed.

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List of Acronyms and Institutions

AFD – French Development Agency
CC – Climate Change
CCS – Carbon Capture and Storage
CW – Constructed Wetlands
EbM – Ecosystem-based Adaptation
EbM – Ecosystem-based Mitigation
ER – Emission Reduction
FEBRABAN – *Federação Brasileira de Bancos* (Brazilian Federation of Banks)
FONAG – Fund for the Protection of Water
G&NIn – Green/Natural Infrastructure
GDP – Gross Domestic Product
GHG – Greenhouse Gases
GrayIn – Gray Infrastructure
IBIO – *Instituto BioAtlântica* (BioAtlantic Institute)
IDB – Inter-American Development Bank
ILM – Integrated Landscape Management
iNDC – Nationally Determined Contribution
IPCC – Intergovernmental Panel on Climate Change
IUCN – International Union for the Conservation of Nature
IWRM – Integrated Water Resources Management
NbS – Nature-based Solutions
OECD – Organization for Economic Co-operation and Development
PES – Payments for Environmental Services
RBC – River Basin Committee
SNIRH – National Water Resources Information System (acronym in Portuguese)
TNC – The Nature Conservancy
UNFCCC – United Nations Framework Convention on Climate Change
WRI – World Resources Institute
WWF – World Water Forum

Introduction

The Regulatory Agency for Water, Energy and Sanitation of the Federal District - ADASA, in partnership with the National Water and Sanitation Agency (ANA), and the World Water Council (WWC), had the honor of organizing the largest event on water and sanitation ever held on the planet, the 8th World Water Forum, with participation from more than 120,000 individuals from 172 countries. This Forum took place in Brasília, from March 18th to March 23th, 2018 under the theme *"Sharing Water"*.

Experts consider the Forum to be much more than an event that takes place every 3 years. It is a permanent process of reflection and discussion of issues related to water and its different dimensions: technical, political, social, economic, cultural, environmental, spiritual, development-related, among others. In keeping with the Forum's spirit of sharing, ADASA, through the publication of this document, seeks to systematize the results and discussions stemming from the 8th World Water Forum as a means of contributing to the sequence of discussions and fostering the necessary advances in water and sanitation sectors worldwide.

This publication is the result of a study coordinated by ADASA providing an extensive analysis of the discussions and documents generated during the Forum and is divided into three major thematic perspectives: *"Water and the Environment", "Water and Development",* and *"Water and Society"*. Studies focusing on each of these themes generated three publications/volumes on the 8th World Water Forum: Results and Discussions.

As part of these efforts, after the systematization of the audio and reports for the approximately 300 sessions that took place during the event (more than 400 hours of recordings), a single methodology was established for the analysis and identification of the main sessions to be assessed as part of each of the studies. Different working groups subsequently reviewed the sessions and analyzed documents in order to identify initiatives, ideas, comments, and experiences that would guide discussions and indicate trends and recommendations in relation to the proposed themes.

In this first volume, which deals with the theme *"Water and the Environment"*, the main messages on three selected key topics were extracted, summarized and indicated: climate change, nature-based solutions (NbS), and the financing of the NbS.

We hope that the results of the effort made as part of these publications can contribute to the continuous improvement of initiatives implemented by the sectors involved, not only with regards to ADASA's activities, but to those institutions and actors working in the areas of water resources and basic sanitation in other parts of the world as well.

Raimundo Ribeiro
ADASA's CEO

Executive Summary

The World Water Forum (WWF), organized by the World Water Council together with institutions from the host city and country, is the largest event on water held worldwide and takes place every three years on an itinerant basis. Its 8th edition took place in Brasília, Brazil, from March 18th to 23th, 2018, under the theme *"Sharing Water",* and the event was co-organized by the Regulatory Agency for Water, Energy and Sanitation of the Federal District (Adasa) and the National Water and Sanitation Agency (ANA). Most of the sessions and discussions held were recorded and the respective documents were organized and systematized by Adasa in a database.

This publication is the result of a study, coordinated by Adasa, which promoted an extensive analysis of the sessions held at the 8th World Water Forum and is divided into three major thematic areas: *"Water and the Environment", "Water and Development",* and *"Water and Society".* The publication is presented in three volumes, one for each thematic area mentioned above.

This volume analyzes the content of this database with the aim of identifying trends and generating recommendations to support water resources management policies, both for Adasa and for stakeholders around the world under the theme of *"Water and the Environment".* This document presents an overview of the main technical and strategic discussions with regards to this theme held during the 8th WWF.

Considering the large quantity of data stored for the 8th WWF and the relevance of the more than 400 hours of sessions recorded as the most reliable data source available, a mixed-analysis methodological design was developed, which combined data mining techniques that provided support in prioritizing the most relevant sessions, followed by listening, interpretation, and the systematic recording of the key messages from these sessions. The analysis was therefore divided into a primary stage of quantitative analysis, followed by a secondary qualitative stage.

The first step consisted of a statistical analysis of the database using the MaxQDA application, which allows the search, organization, and quantification of

codes (categorized text excerpts) in textual data. After establishing the codes based on keyword clouds relevant to the analyzed topics, it was possible to analyze the frequency and distribution of these codes in the sessions and thereby prioritize the sessions for a more detailed hermeneutic analysis.

The codes established for the Water and Environment theme followed 3 topics: climate change (CC), which appeared in 54% of the documents, nature-based solutions (NbS), which was present in 23% of the documents, and the financing of nature-based solutions, represented in 6% of documents.

Overarching themes were also coded: work scale (global/transnational, national, subnational/local, and Federal District); innovative research and technologies; education and training, and recommendations.

Based on this analysis, the most relevant sessions were selected according to the number of codes they received. Their complementary information reported in audios and documents was subsequently subject to a detailed analysis and systematization.

These efforts resulted in the second stage of the process: the qualitative analysis of the content of text and audio files, also known as hermeneutics. Using the MaxQDA results as input, 36 sessions were selected, 12 for each topic, and the results of the selected presentations were compiled into an analytical matrix, as indicated in Annex 6.

The main insights gained from the efforts to qualitatively assess the material available on the Forum sessions are presented below:

- Water is an important vector, both in terms of effects and solutions, in mitigating the impacts of climate change (CC);
- There is growing recognition that the issue of water plays an important role in adapting to climate change through, above all, increasing efficiency in the management of water resources;
- Adapting to CC in water management requires an integrated approach, using a mix of green/natural and gray infrastructure solutions and focusing on the potential of nature-based solutions (NbS);
- NbS constitute an efficient approach in facing multiple environmental and social issues and are an important element in integrated landscape management (ILM). ILM is a tool used to integrate multiple objectives in the use of the territory as part of sustainable development models; however, it is an approach that is still not widely used in water resources management;
- The topics of training and education, as well as the use of payments for environmental services (PES) as an economic instrument were highlights of analyses performed on sessions referring to NbS;

- Financial funds remain underutilized, especially with regards to water resource projects aimed at mitigating and adapting to CC and the development of NbS;
- The development of blended finance models has been presented as a solution for mitigating the perception of a high financial risk associated with NbS models for commercial banks and/or high cost for implementers;
- There is a need for greater coordination in efforts to mobilize social and environmental impact investments aimed at adopting NbS.

1. Background and context

1.1 8th World Water Forum

The World Water Forum (WWF), held every three years in a selected host city, is organized by the World Water Council together with institutions from the country and the city hosting the event and is currently the world's largest water event. The 8th edition of the WWF was organized by the National Water and Sanitation Agency (ANA), representing the Brazilian Federal Government, and by the Regulatory Agency for Water, Energy and Sanitation (Adasa), which represents the government of the Federal District.

The 8th WWF took place in Brasília from March 18th to March 23rd, 2018, under the theme of "Sharing Water". With the aim of promoting a broad debate on this theme, the 8th WWF brought together different segments of society, with participation from more than 120 thousand people from 172 countries, constituting its largest edition to date. Through means of 283 different sessions, the event featured high-level meetings involving international representatives and expert panels, which addressed the forum's 9 main themes: climate, people, development, urban environment, ecosystems, financing, governance, sharing, and capacity building. In addition to the files associated with the event's presentations, most of the sessions were also recorded, generating a vast volume of information, which was subsequently systematized and organized by Adasa into a single database.

This material was the starting point and the main input used to analyze the treatment given to the themes of *Water and Society, Water and Development, and Water and the Environment,* with the objective of highlighting the most current results, recommendations, and innovations from different sources worldwide.

This volume presents the results for the theme *"Water and the Environment"*, with a focus on three key issues: *Climate Change (CC), Nature-based Solutions (NbS), and Financing Nature-based Solutions.*

The structure of this volume begins with the current contextualizing of the 8th WWF, followed by a background presentation, and theoretical foundation on the three topics. The section 'Methods' describes the tools used for analysis, as well as the complementary information and contexts. The results are then presented and discussed. The final section presents 'Conclusions and Recommendations' and offers a synthesis of the analysis's main findings, through which paths that are to be taken in relation to the theme of Water and the Environment are recommended.

1.2 Background and Theoretical Foundations

1.2.1 Water and Ecosystems

Considering the crucial role that water plays in all relationships, whether human or related to the ecosystem, or those that arise from the interactions between both aspects, sustainable management of this resource through means of an integrated and holistic vision that considers the complexity of the interactions of these systems is necessary. The intrinsic interdependent relationships between human beings and the environment can be better understood through the role ecosystem services play in maintaining human society and the ecological environment that sustains it. Ecosystem services consist of the different benefits that humans obtain from ecosystems[1] and can be classified into the following categories: supply, support, regulation, or cultural services. Water-related services are permeated throughout these categories and are of essential importance to human well-being[2] and fundamental rights.

An example of this are the services stemming from the maintenance and restoration of natural ecosystems, such as the quality and quantity of water for human supply, flood regulation, and the production of natural enemies that control the growth of pests in agriculture. Additionally, bodies of water present aesthetic, religious, historical, and archaeological values that are important for society's social memory and cultural heritage.[3]

The loss of natural habitats as a result of urbanization, expansion of agriculture, deforestation, and pollution are among the factors that most negatively influence the resilience of ecosystems and, consequently, the maintenance of important ecosystem services. There are several ecosystems that are currently

[1] MILLENIUM Ecosystem Assessment (Program). Ecosystems and human well-being: a framework of assessment. United States of America: Island press, 2005.

[2] BRAUMAN, Kate A., et al. The nature and value of ecosystem services: an overview highlighting hydrologic services. Annu. Rev. Environ. Resour., 2007, 32: 67-98.

[3] FORSLUND, A., et al. Securing Water for Ecosystems and Human Well-being: The Importance of Environmental Flows. Swedish Water House Report 24. SIWI, 2009.

in decline throughout the world, most notably wetlands that play a key role in the water cycle. Many recharge areas, which supply groundwater, are also threatened – it is estimated that 20% of the planet's aquifers are exploited beyond their capacity to recover.[4]

It is also believed that demand for water, which is currently growing at a rate of 1% per year, will increase significantly over the next two decades[5]. This advance is influenced by factors such as population growth and the consumption of goods, which follow a linear trend of production expansion based on the continuous extraction of natural resources and contribute to an environmental imbalance and the consequent alteration of complex mechanisms such as the regulation of Earth's climate.

In this scenario, the preservation of fresh water gains a strategic dimension in the economic development of any nation. This also applies to Brazil, which, despite having about 19.0% of all fresh surface water that flows through the planet's rivers, with 13.5% of this total generated in its own territory[6], experiences situations of water stress resulting from inequalities in the distribution of supply, demand, and the quality of these resources.

The country is also home to two of the most important wetlands on the planet: the Pantanal and the Amazon Basin, which serve as the habitat for more than 3,000 species of freshwater fish, most of which are endemic. It is estimated that the Amazon Basin has more fish species than the entire Atlantic Ocean[4].

Despite advances made in terms of national regulations and international agreements in this area, few countries have made sufficient investments in implementing effective measures to protect water resources[7]. Ecosystem services often remain ignored, under-recognized and under-utilized within most economic, management, and public policy approaches. Varied and competing demands impose difficult resource allocation decisions and limit the expansion of critical sectors in sustainable development, particularly for food production and the energy sector. A more holistic focus that is capable of articulating society's needs and the conditions necessary for the preservation of natural ecosystems, would provide a variety of benefits, thereby maximizing the value of the landscape for human beings and other forms of life.

It is therefore crucial that we fully understand and apply global, national, and local mechanisms that seek to engage people in nature-based solutions,

[4] PIRES, A. P. F et al. 2019. Summary of the Thematic Water Report for Decision Makers (STD): biodiversity, ecosystem services, and human well-being in Brazil. Editora Cubo, São Carlos

[5] KONCAGUL, E., et al. Nature-based solutions for water management: executive summary: facts and data: United Nations World Report on Water Resources Development 2018. 2018.

[6] LIMA, J. E. F. W Water resources in Brazil and the world. Planaltina: Embrapa Cerrados (Documents Series n.33). 46p. 2001.

[7] LE QUESNE, T., KENDY, E. & WESTON, D. The Implementation Challenge: Taking stock of government policies to protect and restore environmental flows. WWF and TNC. 2010

especially those that promote the health of systems playing an important role in the production of fresh water, nurturing a healthy relationship between human societies and the ecosystems in which they are inserted.

In keeping with this need, one of the results of the 8th World Water Forum was the preparation of the first Declaration of Sustainability[8] in the history of the WWF. The document, which was prepared by the Sustainability Focus Group, provides a record of the commitment made by the parties involved in facing the growing challenges related to water and answering calls for the urgent mobilization of all sectors in order to guarantee a sustainable future for all.

Among the recommendations proposed in the document, is the need to consider the wide-reaching nature of water as a basis for the implementation of an efficient integrated management that considers not only the terrestrial/surface portion of the water cycle, but the entire chain involving the different ecosystems that together make up a unique hydrological cycle. One of the implementation strategies is to consider this resource at different levels throughout the watershed.

1.2.2 Ecosystem and landscape approaches in integrated watershed management

Watershed is a water resources management planning unit offering its own specific ecosystem and social contexts. The effective management of watersheds[9] depends on instruments capable of interconnecting social and ecological systems and allowing public policy to be formed in a manner that is innovative and participatory. In Brazil, the instruments instituted under the National Water Resources Policy, Federal Law No. 9.433 of the 8th of January 1997, include the following items: water resources management plans, the classification of water bodies by usage, the granting of the right to use, charging for the use of these resources, and the water resources information system (the National Water Resources Information System – SNIRH Portal)[10]. The methodologies used in ecosystem-based management[11], Integrated Water Resources Manage-

[8] Sustainability Statement 8th World Water Forum. Available at: http://8.worldwaterforum.org/pt-br/documents-0

[9] DARGHOUTH, Salah, et al. Watershed management approaches, policies, and operations: lessons for scaling up. 2008. "Watershed management is the integrated use of land, vegetation and water in a geographically distinct drainage area for the benefit of its residents, with the objective of protecting or conserving the hydrological services that the watershed provides and reducing or preventing negative impacts downstream or to groundwater".

[10] Portal for the National Water Resources Information System – SNIRH. Available at: https://www.snirh.gov.br/

[11] McLeod, K.; Leslie, H. Ecosystem-based management for the oceans. Washington: Island Press, 2009. "Ecosystem-based management is an environmental management approach that recognizes the full range of interactions within an ecosystem, including human activity, rather than considering isolated ecosystem issues, species or services."

ment (IWRM),[12] and Integrated Landscape Management (ILM)[13] are examples of tools that are used to effectively preserve biodiversity and foster sustainable development. While ecosystem-based management focuses on managing human activity in the maintenance of ecosystem services and sustainable socioeconomic development, IWRM is a systematic process that seeks to promote the coordinated management of water resources and land use and other related resources in order to maximize social and economic welfare in an equitable manner, without compromising the sustainability of vital ecosystems[13].

Under these approaches, the structure and ecosystem processes present in landscapes are considered and managed in a manner that is spatially explicit, taking the socioeconomic, biophysical, cultural, and institutional context into consideration. All processes forming part of a given landscape, whether ecological, social or economic, are defined and affected by the physical space in which they are inserted, including areas of human use (in general, agricultural or urban areas, which constitute the matrix of anthropized landscapes), the remnants of native vegetation, and the hydrographic network from a perspective of ecological connectivity and multiple uses.

These approaches emphasize interactions between landscape units, in particular the mutual influences between areas converted by humans and native areas, thereby allowing a full and more synergistic understanding of cause-effect relationships existing between changes in landscape configuration, the use of water resources, and their effects on the hydrological cycle. The ecosystem-based perspective of each unit of the terrestrial and aquatic landscape is thereby expanded and the influences of neighboring units are taken into consideration, seeking to understand and act upon the interactional links existing between a variety of diverse landscape units.

The use of landscape approaches has been increasing in the context of discussions on land use dynamics and their implications for biodiversity conservation, water resources management, and agricultural and forestry production. Its broad scope covering social, economic, and environmental components makes it very suitable to respond, simultaneously and in a coordinated manner, to questions related to the dynamics of land use, such as: increases in agricultural and forestry productivity; the conservation of soil and water resources; pollution control; erosion and sedimentation control; conservation of remnants of native vegetation and water bodies; management of protected areas; land use planning; implementation of legislation and policies (such as, in the Brazilian case, the Law

[12] GWP (Editor) (2004): Catalyzing Change: A handbook for developing IWRM and water efficiency strategies. Stockholm: Global Water Partnership (GWP)

[13] An integrated landscape management approach is one that considers, in a spatially explicit way, the influence of the spatial context on the processes that occur in the area of interest.

for the Protection of Native Vegetation – New Brazilian Forest Code – Federal Law No. 12.651 of the 25th of May 2012, and the National Strategy for Reducing Emissions from Deforestation and Forest Degradation); sustainable exploitation of native forests; payments for environmental services; mitigating and adapting to climate change; among other issues.

Considering that the conservation of water resources is only possible when it is carried out with participation from governments, civil society, and private sector stakeholders, integrating and coordinating these entities is fundamental to improving the flow of communication and establishing a democratic environment in which viable solutions aimed at resolving conflicts are developed. Integration must be carried out to recognize and meet the different demands faced by each sector of society, and it is within this context that the River Basin Committees (RBC) are inserted.

An RBC[14] is a permanent forum in which representatives from all sectors benefiting from the water resources provided by a specific river basin, together with representatives from the government and civil society, meet to discuss different interests and outline common strategies, with the aim of guaranteeing good quality water in sufficient quantity for all forms of use.

Aligning integrated approaches that take not only the different parts of the ecosystem and the landscape into consideration, but also the different sectors of society and their needs, is essential in developing efficient strategies for reconciling the conservation of ecosystems with improvements in quality of life. One of the benefits stemming from this type of approach is climate change mitigation, which is described in more detail in the following section.

1.2.3 Climate Change (CC)

According to the *World Economic Forum* report published in 2018, water will play a role in 4 of the 5 biggest risks to the global economy over the next 10 years (water crises, extreme weather events, natural disasters, and the failure to mitigate and adapt to climate change). The first factor on this list, and the only one which is not related to water, refers to the risks arising from weapons of mass destruction[15].

Water is the primary means through which humans will feel the effects of climate change. For this reason, it is crucial to adopt strategies that mitigate extreme weather events that, in addition to affecting water availability, cause

[14] With the approval of Federal Law No. 9.433 of the 8th of January 1997, which defined Brazil's National Water Resources Policy (PNRH) and instituted the National Water Resources Management System (SINGREH), the Hydrographic Basin Committees (CBH) are now defined as members of SINGREH and participate in the regional management of PNRH and SINGREH.

[15] WORLD ECONOMIC FORUM. The Global Risks Report 2018, 13th edition. Geneva. 2018.

droughts and floods, and increase the risks of contamination of water sources. In some regions of the world, increasingly extreme droughts exacerbate water scarcity and negatively affect human health, as well as agricultural and industrial production.

Current trends suggest that such effects will increase considerably throughout this century, resulting in changes in aquatic habitats, a drastic loss of biodiversity, and waves of conflict resulting from migratory flows related to water stress. Floods cause about US$ 120 billion in damage each year worldwide, and droughts are responsible for slowing the average growth in gross domestic product (GDP) per capita by 0.5%. It is expected that these numbers will increase over the course of the coming years[16].

In Brazil, prolonged droughts in the Southeast and Center West regions have already resulted in R$ 20 billion in lost agricultural revenue in 2015[17].

Among affected areas, wetlands are extremely vulnerable to climate change. For example, the Brazilian Pantanal, the largest wetland on the planet, which constitutes an area of great environmental importance, one that plays an important role in the regulation of hydrological flows in the Paraguay River basin, is the Brazilian biome that has seen the greatest reduction in water surface over the last 30 years[18]. Such characteristics are not restricted to the Pantanal; they can also be observed in the Amazon and in other biomes, including mangrove and floodplain areas[19].

Climate change will affect environmental flows in all the world's watersheds. Wetland filling and draining impact water availability and can result in an increase in the sediment that is transported to the sea, thereby having a negative effect on the resilience of all ecosystems, whether terrestrial or aquatic. Decreasing aquifer levels will result in the drying up of wells, geological subsidence, the intrusion of saline waters, and other issues, not only in terms of the environment, but also in relation to human economic activities. The combination of these different categories of impacts diminishes the ability of ecosystems to repair themselves, until they reach a breaking point and lose the ability to adapt to sudden changes.

[16] JOHANNES COLLMAN – WMO (2018), orally at the 8th WWF, 2018

[17] PIRES, A. P. F et al. (2019). Summary of the Thematic Water Report for Decision Makers (STD): biodiversity, ecosystem services, and human well-being in Brazil. Editora Cubo, São Carlos.

[18] MAPBIOMAS. (2021) The dynamics of surface water in the Brazilian territory. Available at: https://mapbiomas-br-site.s3.amazonaws.com/MapBiomas_A%CC%81gua_Agosto_2021_22082021_OK_v2.pdf.

[19] BARROS, D. F.; ALBERNAZ, A. L. M. (2014). Possible impacts of climate change on wetlands and their biota in the Brazilian Amazon. Brazilian Journal of Biology, 74.4: 810-820.

1.2.4 Strategies for mitigating and adapting to climate change

Mitigation of climate change can be considered to encompass "anthropogenic interventions aimed at reducing the source of emissions and increasing greenhouse gas sinks". These strategies include both the reduction of emissions and the reduction of existing concentrations and the minimization of risks and uncertainties arising from such changes.

Adaptation can therefore be understood as a set of strategies and actions aimed at changing the ecological, social or economic structure of a system in order to respond to these pressures[20]. Adaptation is very closely related to two other concepts -- vulnerability and resilience -- and can be understood as both a reduction of the first and construction of the second.

Mitigation strategies can be used as allies in reducing the need for adaptation strategies.

An integrated approach of the two types aims to act both on the consequences, in the short term, and on the causes, in a long-term vision. Measures aimed at mitigating and adapting to climate change are complementary; therefore, when successfully articulated, these strategies tend to generate more effective and lasting results.

Important approaches commonly used in mitigation in adaptation strategies across a wide range of contexts are listed in Table 1.

Table 1. Main groups of mitigation and adaptation strategies and their respective definitions.

Mitigation Strategies		
ER	Emission Reduction	*"The main path towards mitigating the effects of climate change is to prevent greenhouse gases - GHG from accumulating in the atmosphere by reducing emissions directly at their sources"*
CCS	Carbon Capture and Storage	*"Technologies or processes that remove GHG already present in the atmosphere"*
Adaptation Strategies		
GrayIn	Gray Infrastructure	*"Infrastructure built and developed by humans"*[21]
G&NInf	Green or Natural Infrastructure	*"A strategically planned network of natural and semi-natural areas containing other environmental resources designed and managed to provide a wide range of ecosystem services"*[22]
GrayIn + G&NIn	Gray and Green Infrastructures	*"The combination of gray and green/ natural infrastructure approaches"*

[20] ADGER, W. N.; ARNELL, N. W.; TOMPKINS, E. L. (2005). Successful adaptation to climate change across scales. Global environmental change, 15(2), 77-86.

[21] IPCC (2018). Progress report. International Conference on Climate Change and Cities. Forty-eighth session of the IPCC. Incheon, Republic of Korea, 1 – 5 October 2018

[22] GARMENDIA, E. et al. (2016). Biodiversity and Green Infrastructure in Europe: Boundary object or ecological trap? Land Use Policy, v. 56, p. 315-319.

1.2.5 Assessment of vulnerability

An analysis of the effects of climate change must take into account the different contexts of vulnerability seen in communities and environments, which are determined both by their location and by the manner in which they are managed. Vulnerability to climate change can be summarized as the "propensity to suffer harm", according to a 2014 report by the Intergovernmental Panel on Climate Change – IPCC[23].

Carrying out evaluations to measure the efficiency of local governments and the resilience of these communities in the face of CC depends upon a careful assessment of each reality. One of the factors that is widely accepted are economic aspects, in which the poorest communities are the most vulnerable, often lacking access to basic services such as clean water and sanitation.

Vulnerability analyses aimed at defining the risks to which each community is subject are carried out by taking the relationship between three different criteria into consideration: exposure, sensitivity, and adaptive capacity. The concepts adopted for each of these terms, as well as for resilience, based on their direct relationship with the theme are described in Table 2.

Table 2. Definitions of terms related to the context of climate change according to the 2001 IPCC Report.

Vulnerability and its components	
Vulnerability	*"The degree to which a system is susceptible or unable to cope with the adverse effects of climate change, including climate variability and extreme events. Vulnerability is a function of the character, magnitude and rate of variation in the climate to which a system is exposed, its sensitivity to such changes, and its adaptive capacity."*[24]
Exposure	*"The nature and degree to which a system is exposed to significant variations in climate."*[24]
Sensitivity	*"The degree to which a system is affected, either in an adverse or beneficial manner, by climate-related stimuli. Effects can be both direct or indirect."*[24]
Adaptive capacity	*"The ability of a system to adjust to climate change (including climate variability and extremes) in order to moderate potential harm, seize opportunities, or deal with associated consequences."*
Resilience	*"The amount of resistance and the adaptive capacity of a system after an extreme event"*

[23] IPCC (2014). Climate Change 2014: Mitigation of Climate Change. Fifth Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge: IPCC)

[24] IPCC (2001). Climate Change 2001: Synthesis Report. A Contribution of Working Groups I, II, III to the Third Assessment Report of the Intergovernmental Panel on Climate Change (Cambridge: IPCC)

1.2.6 Water, nature-based solutions (NbS) and water resilience

Despite enormous contributions made by civil engineering, which is classified as gray infrastructure, in the establishment and development of infrastructure solutions, it is increasingly less likely that engineering alone will be able to continue to provide the necessary water security and resilience in the face of the expected impacts of changes in weather[25]. It is therefore necessary to develop new technologies and employ practices that take the intrinsic relationships of the environment into consideration to ensure that this infrastructure is more efficient and long-lasting. An example of these new practices is the integration of green/natural infrastructures into gray infrastructure in a coordinated and integrated manner. Other solutions can also be found when the specific environmental contexts of each area or region in which they will be applied are taken into consideration.

Nature-based Solutions (NbS) is a concept that includes any actions taken to protect, sustainably manage, and restore natural or altered ecosystems that contribute to overcoming the challenges of contemporary society (such as climate change, food and water security, and natural disasters) in an effective and adaptive manner, while ensuring human well-being and benefiting biodiversity[26].

> *"NbS are living solutions that are inspired and continuously supported by nature. They are designed to address multiple societal challenges in an efficient and adaptable manner while offering economic, social and environmental benefits."*[27]

NbS offer the unique advantage of supporting the pillars of the circular economy and the green economy (and simultaneously receiving reciprocal support), in which natural resources are used in a sustainable manner involving greater productivity and the reduction of waste, thereby allowing the environment to be regenerated through the reuse and recycling of materials[28].

Since NbS aim to solve multiple socio-environmental problems, their actions are usually orchestrated in conjunction with other types of interventions associated with different types of engineering such as civil, sanitary, hydraulic, and agronomic, etc. Taking a scenario in which multiple simultaneous water or

[25] DALTON, J.; MURTI, R.; CHANDRA, A. (2013). Using Integrated Water Resource Management Approaches to Support Disaster Risk Reduction. In: F. Renaud, K. Sudmeier-Rieux & M. Estrella, eds. The role of ecosystems in disaster risk reduction. Geneva: United Nations University, p. 248-269.

[26] COHEN-SHACHAM, E. et al. (ed.). Nature-based solutions to address global societal challenges. [s.l.] IUCN International Union for Conservation of Nature, 2016.

[27] MAES, J.; JACOBS, S. (2017) Nature-Based Solutions for Europe's Sustainable Development. Conservation Letters, v. 10, no. 1, p. 121–124.

[28] KONCAGUL, E., et al. (2018). Nature-based solutions for water management: executive summary: facts and data: United Nations World Report on Water Resources Development 2018.

food security issues and the risk of landslide exist, for example, it is necessary to employ a combination of measures. NbS strategies can therefore be used, including the introduction of agroforestry systems and the ecological restoration of landslide sensitive areas, solutions involving green/natural infrastructure, or the use of conventional solutions. This integration of solutions should support and strengthen a set of ecosystem services, thereby contributing to the overall resilience of systems28. It is necessary that smart solutions using gray and green/natural infrastructure be sought out in ensuring efficient and effective water resources management[29].

NbS is a new term in environmental research, policy, and science and seeks to promote economic development with a focus on ecological balance[30]. It is primarily used in communication with policy makers and has been widely disseminated by global institutions such as the International Union for Conservation of Nature (IUCN), the United Nations Framework Convention on Climate Change (UNFCCC), and the European Commission for the Environment, among others[31].

To be classified as NbS, a series of measures must adhere to the following requirements:

1. Promote nature conservation;
2. Be executed by nature itself or integrated with other solutions (for example, technological or engineering solutions);
3. Respect the cultural context into which it is inserted, including traditions and customs and local and scientific knowledge;
4. Produce benefits in a fair and equitable manner, promoting transparency and wide-ranging social participation;
5. Increase or maintain biological and cultural diversity, as well as the ability of ecosystems to evolve over time;
6. Be applied at the landscape scale;
7. Recognize and resolve issues related to compensation for economic losses at the expense of maintaining or restoring ecosystem services (e.g., payments for environmental services); and
8. Be an integral part of public policies aimed at facing specific challenges.

[29] OZMENT, S.; DIFRANCESCO, K.; GARTNER, T. (2015). The role of natural infrastructure in the water, energy, and food nexus. Nexus Dialogue Synthesis Papers. Gland, Switzerland: IUCN

[30] NESSHÖVER, C. et al. (2017). The Science, Policy and Practice of Nature-Based Solutions: An Interdisciplinary Perspective. Science of The Total Environment, v. 579, p. 1215–1227.

[31] COHEN-SHACHAM, E. et al. (2016). Nature-based solutions to address global societal challenges. [s.l.] IUCN International Union for Conservation of Nature.
DURAIAPPAH, AK et al. (2005). Ecosystems and Human Well-Being: Biodiversity Synthesis; a Report of the Millennium Ecosystem Assessment.

Eight main approaches are considered to characterize an intervention based on NbS (Table 3).

Table 3. Definitions of the main approaches that characterize an intervention based on nature-based solutions.

Ecosystem restoration approach		
EcR	Ecological restoration	*"The process of assisting the recovery of a natural ecosystem that has been degraded, damaged, or destroyed"*[32]
EE	Ecological engineering	*"A manner in which environmental issues such as wastewater treatment, recycling, and pollution is addressed"*[33]
FLR	Forest Landscape Restoration	*"A planned process that aims to restore ecological functionality and improve human well-being in deforested or degraded landscapes"*[34]
Ecosystem approaches related to specific problems		
EbA or CSA	Ecosystem-based adaptation or Climate services adaptation	*EbA is an"approach that aims to ensure continued ecosystem functionality, human health, and socio-economic security through means of carbon storage"*[35] *CSA is the "sustainable management, conservation and restoration of ecosystems, as part of an overall adaptation strategy that takes into account multiple social, economic and cultural benefits to local communities"*[36]
EbM	Ecosystem-based mitigation	*EbM focuses on understanding the key mechanisms and ecological characteristics supporting the ability of ecosystems to adapt to change*[37]
eco-DRR	Ecosystem-based disaster risk reduction	*The eco-DRR approach is primarily focused on minimizing the impacts of risk events, enhancing the capacity of humans to better manage and recover from the effects of hazards*[38]*.*
G&NIn/ NatInf	Green or natural infrastructure	*"A strategically planned network of natural and semi-natural areas containing other environmental resources designed and managed to provide a wide range of ecosystem services"*[39]

[32] TEMPERTON, V. M. et al. (2012). Assembly rules and restoration ecology: bridging the gap between theory and practice. Island Press, 2004.

[33] STOKES, A. et al. (2012) Ecological engineering: from concepts to applications. Ecological Engineering, v. 45, p. 1-4.

[34] MANSOURIAN, S.; VALLAURI, D. (2005). Forest restoration in landscapes: beyond planting trees. Springer Science & Business Media.

[35] UNFCCC (2008). Fact Sheet. The need for mitigation. 2008-09-07]. http//unfccc. Int/press/items/2794. php.

[36] DOBSON, A. (2005). Monitoring global rates of biodiversity change: challenges that arise in meeting the Convention on Biological Diversity (CBD) 2010 goals. Philosophical Transactions of the Royal Society B: Biological Sciences, v. 360, n. 1454, p. 229-241

[37] BENNETT, E.M. et al. (2015). Linking biodiversity, ecosystem services, and human well-being: three challenges for designing research for sustainability. Current opinion in environmental sustainability, v. 14, p. 76-85.

[38] ALEXANDER, D.E. (2013). Resilience and disaster risk reduction: an etymological journey. Natural hazards and earth system sciences, v. 13, no. 11, p. 2707-2716.

[39] GARMENDIA, E. et al. (2016). Biodiversity and Green Infrastructure in Europe: Boundary object or ecological trap?. Land Use Policy, v. 56, p. 315-319.

1.2.7 Financing Nature-based Solutions

Despite measures historically being carried out under other nomenclatures, NbS have only recently arrived on the stage of infrastructure-based solutions, which means their financing is also an underdeveloped area, the formulation and consolidation of which have been advanced in recent years.

Ecosystem services must be looked at not only from a financial standpoint in analyses of return on investments whose associated positive externalities are often not considered, but also as being fundamental in mitigating climate change, providing resources, and maintaining an ecological balance. Mechanisms capable of capturing these services are extremely important for the feasibility of projects that work to maintain and promote NbS.

According to the 2018 United Nations World Water Development Report, despite rapid growth in investments in NbS, they correspond to less than 1% of the total invested in infrastructure for the management of water resources. Even though their effectiveness has been proven and they often do not require additional financial resources (only redirection or more effective use of available investments), NbS are often ignored in the development of water resources management policies[40].

Among the possible NbS measures focused on mitigating climate change, those related to the maintenance and increase of forest cover are the most common and are generally implemented through means of partnerships between the private sector, non-governmental organizations, and stakeholders[41].

Financing from more than one source is called blended finance, defined by the Organization for Economic Co-operation and Development (OECD) as the "strategic use of development finance for the mobilization of additional finance towards sustainable development in developing countries", with the objective of attracting commercial capital for projects.[42]

To be efficient and effective, NbS financing requires innovative arrangement models in which resources are the result of a combination of debt and net or equity capital (equity). In many cases involving NbS, funding is provided through intermediaries such as private or development banks or dedicated funds. These actors therefore act as aggregative bodies expanding access to capital for smaller and higher-risk projects, reducing transaction costs, and benefiting in some cases from the support of public banks. The main sources of NbS financing are

[40] KONCAGUL, E., et al. Nature-based solutions for water management: executive summary: facts and data: United Nations World Report on Water Resources Development 2018.

[41] GRISCOM, B.W., et al. (2017). Natural climate solutions. Proceedings of the National Academy of Sciences, 114.44: 11645-11650.

[42] OECD. (2021). Blended Finance Unlocking Commercial Finance for the Sustainable Development Goals. Available at: http://www.oecd.org/development/financing-sustainable-development/blended-finance-principles/

presented in Table 4 according to three separate classifications in terms of their implementation: commercial, concessional, or mixed.

Table 4. Funding Sources for Nature-based Solutions[43].

Commercial financing	Concessional financing	Mixed financing
Sources	**Sources**	**Combining mechanisms**
Public development banks	Public institutions, e.g. EU or EIB programs)	Commercial financing
Private financial institutions (e.g. banks or endowment funds)	Private institutions (eg philanthropists, NGOs, etc.)	Concessional financing

In addition to the funding sources described in Table 4, an option that has seen rapid growth internationally is the green bond market[44] (which grew from US$ 37 billion in 2014 to US$ 167.3 billion in 2018, according to the *Climate Bonds Initiative*[45]). These financial instruments should essentially help to enable large-scale sustainable activities of a financial nature to access capital at a lower cost.

For the sustainable management of water resources, the Brazilian Federation of Banks – FEBRABAN[46] cites the following activities as being eligible to receive financing through green bonds: water treatment and depollution, infrastructure for capturing, storing, and distributing water, watershed protection, and sustainable urban drainage and flood control systems. The category *Sustainable Management of Natural Resources* includes: low-carbon agriculture, conservation, restoration, and recomposition of native vegetation, and the recovery of degraded areas. The *Biodiversity Conservation* category includes the protection of terrestrial, coastal, marine, river and lake habitats, sustainable use, and the implementation of ecological corridors. Issuing of these bonds can be carried out directly or in the manner indicated by companies and commercial, national development, and multilateral banks, credit agencies, and local and regional governments. In 2018, most of these resources on a global scale were allocated to the energy sector (52%), land use (10%), and water (5%)[47].

NbS financing still does not generally make use of the issuing of green bonds. In a similar manner, investments aimed at financial profitability still do not play a role in the formulation and implementation of NbS, whether in proofs of

[43] Translated and adapted from https://www.eib.org/attachments/pj/ncff-invest-nature-report-en.pdf

[44] Debt securities to raise funds to implement or refinance projects and purchase assets that generate benefits for the environment, including mitigation and adaptation to climate change. In Brazil, the following classifications can be made: Quotas of Investment Funds in Credit Rights (FIDC), debentures, infrastructure-incentivized debentures, Financial Bills (LF), promissory notes, Agribusiness Receivables Certificate (CRA), and Real Estate Receivables Certificate (CRI),

[45] https://www.climatebonds.net/market/explaining-green-bonds

[46] https://cmsportal.febraban.org.br/Arquivos/documentos/PDF/Guia_emissão_t%C3%ADtulos_verdes_PORT.pdf

[47] https://www.climatebonds.net/files/reports/cbi_gbm_final_032019_web.pdf

concept, experimental or pilot projects, and much less in expanding the scope of more complex applications, whether on the spatial scale, in institutional arrangements, or in the ecological processes involved.

There is still a great aversion to risk, either due to the absence of solid business models based on well-established time series, or the lack of established and successful cases due to the innovative and relatively recent character of NbS, or difficulty in implementation mechanisms that guarantee a minimum level of profitability. Innovative pilot projects with a history of learning and organized data struggle to raise the capital needed to leverage the implementation of NbS financing.

Increasing the amount of financial flows for these NbS models is challenging, as the few consolidated cases do not generate the information necessary for robust risk analyses. Investments in pilot projects are also still generally lacking.

NbS still therefore need to demonstrate the capacity to generate sufficient income to pay for the investments required. It is essential that governments and public-private partnerships create more favorable environments for innovative business models. This innovation takes place across three main elements: a) the creation of value for customers in the form of a marketed product or service; b) architecture for delivering this value (resources, partners, and networks); or c) value capture (revenues and costs[48]).

The transition from a conventional scenario to NbS will depend on the synergy between risk mitigation actions, the ability to bear the burden of implementation costs and cash flow during the initial phase. The resulting multiple benefits include the restoration of forests and degraded areas, food security, protection of ecosystem services (nature's contributions to humankind), and economic security with reduced vulnerability to climate change.

Most banks also consider investments in NbS as being very risky, making it difficult to access long-term financing to make projects with a long maturity viable. Funds have been created to encourage commercial debt providers to remove these barriers, both with financial solutions and in the provision of technical assistance.

[48] WIRTZ, B. W., PISTOIA, A., ULLRICH, S.; GÖTTEL, V. (2016). Business Models: Origin, Development and Future Research Perspectives. Long Range Planning, 49(1), 36–54. https://doi.org/10.1016/j.lrp.2015.04.001

2. Methods

For a better understanding of the analysis of the sessions of the 8th World Water Forum, below are presented the process of identification of the relevant sessions, the quantitative analysis, and the qualitative analysis of the information contained in the presentations and associated documents.

2.1 Organization of the 8th World Water Forum

Discussions held as part of the 8th Water Forum were structured using a thematic matrix that is further divided into 6 main themes: climate, people, development, the urban environment, ecosystems, and financing. Three overarching themes were also defined to guide the Forum's thematic discussions: capacity building, sharing, and governance (Figure 1).

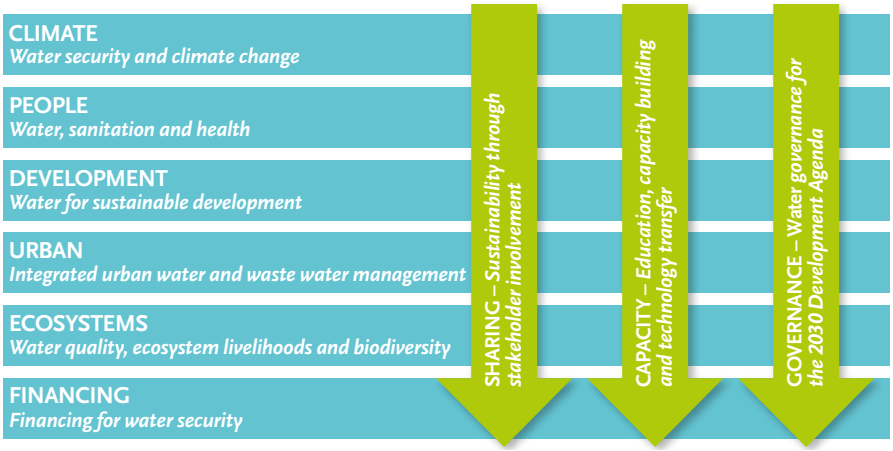


Figure 1. Thematic structure of the 8th World Water Forum.

Discussion sessions were organized according to the themes of this matrix, their target audiences, and the objectives of the session itself. To this end, 5 specific processes were considered for the classification of sessions, which identification acronyms were created from their titles in English (Table 5).

Table 5. Process adopted in organizing the sessions of the 8th World Water Forum[1].

Acronym	Process	Objectives
TP	**Thematic**	To discuss the topics to be addressed in the Forum
PP	**Political**	To involve government at the local, regional, and national levels, members of legislative bodies, focusing on the establishment of memoranda of understanding, agreements, and cooperation treaties for integrated water management.
RP	**Regional**	To discuss different issues and guidelines for cooperation and integrated water management for each continent or in geographic region
SFG	**Sustainability Focus Group**	To discuss adherence to public policy and initiatives and principles of sustainable development (economic, social, and environmental) in a general manner, participating in other processes
CF	**Citizens Forum**	To promote the participation of organized civil society in discussions, exchanges of experiences, and the Forum's other activities

The forum's sessions were grouped according to their specific characteristics, and their acronyms were created using their titles in English (Table 6).

Table 6. Types of sessions held at the 8th World Water Forum.

Acronym	Title	Objectives
HLP	**High Level Panel**	Participation of authorities and representatives from organizations relevant to the water debate
OS	**Ordinary Sessions**	Promotion of debate and the sharing of experiences within the scope of each Forum process
SS	**Special Sessions**	Discussion between more than one process, provided by organization or the opening/ completion of a series of sessions
PP	**Political Process**	Conferences that meet the specific demands of the following subprocesses:
		National Governments (NG)
		Local and Regional Authorities (LRA)
		Judges and Prosecutors (JP)
		Parliamentarians (PAR)

[1] Adapted from http://8.worldwaterforum.org/pt-br/organizational-structure

Approximately 300 sessions were held, totaling more than 400 recorded hours of discussions held during the 5 days of the 8th World Water Forum (an average of one and a half hours per session). Most of the discussions and presentations were recorded through synthesis documents, videos, audios, statements, reports, and photos. Presentation documents and agendas were also maintained. All the material was organized into a database constituting the main source of information for this publication[2].

Table 7. Summary of the 8th World Water Forum database by session[3].

Category	Audio	Presentations	Rapporteur (Portuguese)	Rapporteur (English)
HLP – High Level Panels	**81%**	**63%**	**100%**	**94%**
OS – Ordinary Sessions				
Citizens Forum	83%	100%	100%	0%
Regional Process	92%	100%	100%	100%
Thematic Processes	95%	100%	98%	100%
PP – Political Process				
Judges and Prosecutors	88%	13%	100%	100%
Local and Regional Authorities	93%	100%	93%	93%
National Governments	89%	0%	89%	89%
Parliamentarians	100%	0%	0%	0%
SS – Special Sessions				
Citizens Forum	100%	67%	100%	0%
Collaborative	83%	83%	92%	83%
Partners	93%	100%	93%	93%
Regional	71%	93%	100%	100%
Sustainability	100%	100%	100%	100%
Thematic	100%	65%	100%	100%

2.2 Forum content analysis methodology

The first phase of the study included data mining[4]. The selection of priority sessions for analysis was based on the extensive audiovisual content to be analyzed and the specific interest in researching the relationship between water and

[2] An example of a session title would be OS-TP-01, being the first ordinary session of the thematic process of the event, or even SS-J-SFG+TP-02, which means the second special joint session from a sustainability focus group and a thematic process.

[3] Videos, photos, agendas, and attendance lists were not considered.

[4] RÄDIKER, S. (2020). Analyzing Open-Ended Survey Questions with MAXQDA. MAXQDA Press.

the environment from the perspective of the following topics: a) climate change; b) nature-based solutions (NbS), and; c) NbS financing.

Data mining consisted in structuring a set of keywords (Annex 1 – Codes and keywords related to topics, as well as in the systematic search of these respective records (coding) of phrases or sentences of interest in text files (e.g. reports and presentations).

The MaxQDA application[5] was used for this purpose, which was developed to automate the process of categorizing and comparing text segments. Through this procedure, it was possible to quantitatively measure the most recurrent topics and, in this way, identify the most relevant sessions for hermeneutic analysis, or a profound analysis of the content of the materials available in the Forum's media bank.

Since hermeneutics – or, in other words, the understanding of the meaning of the text or what gives the data the meaning of information – cannot be automated53 by the use of applications and requires the intervention of an analyst, a worksheet was developed to capture all the information regarding the themes and topics previously defined in a structured and systematic way. A spreadsheet with the structure of the analysis developed for each topic is available in Annex 2 – Session analysis worksheet.

During the hermeneutics phase, all recording materials for each session available in the database were considered, with special emphasis given to the audio material, as it is the most reliable record of the contents of the discussions held and was not considered in the first analysis phase. Thus, it was possible to deepen the content analysis of the sessions prioritized by the previous phase (data mining), confirming or refuting the initial findings and thereby allowing the number of analyzed sessions to be concentrated or expanded.

For the theme 'Water and the Environment', 36 sessions were selected and analyzed (12 for each topic), of which 32 were included in the session record sheet. The other 4 sessions dealt with very broad topics and without presentations of projects or specific initiatives related to the selected topics. In addition to these, 7 sessions among the total analyzed and considered for further investigation involved only closing and broader discussions without presenting practical results.

Prior to the analysis of the sessions, a worksheet was developed with several fields to be filled in, including the session data (name of the presenter, country of origin, etc.) and the details of the information presented. Specific question fields were created for each topic so that they could be filled in after listening to and evaluating the material. The closed question fields had the possibility of

[5] MaxQDA is software used in qualitative analysis and mixed methods research. https://www.maxqda.com

multiple answers with up to three options, some of which were open-ended. The list of fields to be filled in and the questions created can be found in Annex 2 – Session analysis worksheet.

From the worksheet created, an analytical matrix was structured (indicated in Annex 6), which described the main projects and initiatives that contained important findings or information on the three overarching sub-themes defined (*research and innovative technologies, education and training,* and *recommendations*). This analytical matrix was prepared with the aim of keeping the reference of each finding with the session, the title of the lecture and the respective speaker, in addition to identifying the scale of the activities involved (global/transnational, national or subnational/local). Additionally, the matrix presents the compilation of systematized information and is the main source of information for the examples cited in the 'Results' and 'Discussion of the topic "Water and the Environment"' sections of this volume.

In summary, the development of the research carried out can be structured in 9 distinct steps, presented sequentially in Table 8 below.

Table 8. Description of the methodological path adopted for researching topics of interest in the database for the 8th World Water Forum sessions.

Nº	Step	Description
1	*Import and organization of textual databases*	Using the MaxQDA program to analyze information from available files in a pre-established format
2	*Structuring the code set*	Specific keywords that, through means of a lexical search, allow the identification of recurring themes in the text documents
3	*Coding of imported documents*	Use of the codes generated in the previous step to identify text excerpts (textual data mining) in imported documents
4	*Cleaning of the codified database.*	Mechanical removal of coded snippets that were outside the context determined for the code
5	*Quantitative and qualitative analysis of the coded database.*	Quantification of the frequency of topics of interest in available texts is carried out by cross-referencing the set of pre-defined codes;
6	*Determination of focal documents.*	Identification of documents with the highest number of codes and determination of the sessions to be hermeneutically analyzed
7	*Development of a model for completing documents.*	Structuring hermeneutics through the formulation of an electronic spreadsheet used to formalize the systematic process for content analysis of prioritized sessions (Annex 2)

Nº	Step	Description
8	*More in-depth analysis of the contents*	Systematization of information from the documents of the prioritized sessions by completing the electronic spreadsheet developed in the previous step, including consulting other materials available in the database referring to the session. ▸ audio de-recording and listening (basis for analyses); ▸ review of presentations, when available; ▸ summary of relevant aspects related to the subject of the work (reports); and ▸ carrying out additional research related to the subject addressed in the lecture by consulting the Internet, when necessary.
9	*Analysis and construction of the analytical matrix*	Consolidation and review of the analytical matrix based on the recording of information from each lecture and on the prior analysis of the respective contents.

3. Results

The complementary and coordinated use of text mining and hermeneutic methods through means of the establishment of objective criteria and the adoption of well-defined analysis steps, allowed a general and specific picture (quantitative and qualitative) to be developed with regards to themes of interest and the respective topics investigated, the results of which are described and discussed in the following sections.

3.1 Quantitative analysis and data mining

The results presented were generated based on 550 documents that record the contents discussed during 283 sessions of the 8th World Water Forum. In these documents, 7,461 excerpts were coded using 7 codes (3 specific, 1 referring to the work scale, and another 3 referring to overarching themes, each with its set of keywords ranging from 6 to 19 (see Annex 1). Figure 2 presents the frequency of the 3 specific codes generated for the *Water and the Environment* theme:

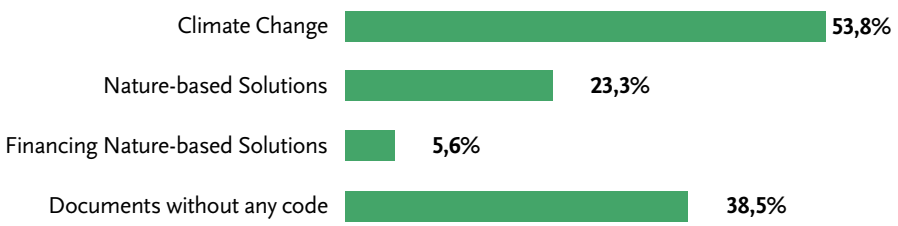


Figure 2. Frequency of documents selected according to the codes adopted for the Water and the Environment theme.

There is an important prevalence of the code '*Adaptation and climate change*', which was associated with 1138 text passages in just over half (54%) of the documents analyzed by MaxQDA. This is likely because it is a comprehensive and overarching topic that is not exclusively limited to the *Water and the Environment* theme. '*Nature-based solutions*' and '*Financing nature-based solutions*' appear respectively in 23.3% and 5.6% of the documents analyzed. The comparatively lower

occurrence of the '*Financing nature-based solutions*' code is likely a reflection of the novelty and specificity of the topic in the context of the 8th Forum and, also, as described above, NbS have only recently appeared on-stage as infrastructure solutions, which makes its financing an issue that is also underdeveloped.

Such frequency of documents according to the three topics was confirmed in the hermeneutics of the sessions, in which, despite having the same sample size of analysis for each of the three axes, more presentations of Climate Change were considered valid (57.6%) than Nature-based Solutions (28.8%) and Financing Nature-based Solutions (13.6%).

3.2 Hermeneutic analysis

Among the 36 sessions selected for hermeneutics (12 for each of the three topics), presentations from 32 sessions were considered for inclusion in this evaluation. In all, 180 presentations were heard, totaling approximately 36 hours of listening. Of these, 74 presentations were considered for inclusion in the analytical worksheet, at a usage rate of 40.5%, which represents approximately 15 hours of recorded audios.

For most sessions, one or two presentations were considered, with 7 being the maximum number of presentations per session, using a model consisting of 5 panelists, 1 main speaker, and 1 moderator responsible for the session. The frequencies of distribution of the number of presentations per session are presented in Table 9.

Table 9. Number of presentations considered in the analyzed sessions (N=32).

Number of Presentations Considered per Session	Number of Sessions	Resulting Number of Presentations Considered
1	11	11
2	11	22
3	4	12
4	3	12
5	1	5
6	2	12
TOTAL	**32**	**74**

From the total 74 presentations considered, 8 were only used as a reference since they are very comprehensive without discussing specific projects or programs, such as the closing speeches of the event. 66 presentations were therefore considered for the analysis of topics. Following the classification in scales used for the elaboration of the analytical matrix, 14 presentations were included from

the total of 19 heard for the global/transnational work scale. For the national scale, 20 out of 25 were included, while for the subnational/local scale, the largest number of presentations was obtained, with a total of 38, out of which 32 were included. For the elaboration of the analytical matrix, 63 presentations were considered, some of which referred to the same project; therefore, the final value excluding overlaps was 59. Sessions with little information relevant to the selected variables were not included in the matrix; however, they were consulted throughout the content analysis.

The presentations were classified according to the type of information presented, taking three categories into consideration: project/program (P), case study (CS) or conceptual (C) (Table 10).

Table 10. Total number of presentations classified according to the scale of work and the type of information presented.

Presentation type	Global/Transnational	National	Subnational/Local	TOTAL
Project/Program (P)	9	12	18	**39**
Case Study (CS)	1	8	14	**23**
Conceptual (C)	4	0	0	**4**
TOTAL	**14**	**20**	**32**	**66**

Case studies and programs/projects become less and less frequent as the scale is increased. An inverse pattern can be found in conceptual presentations, which were all concentrated on the global/transnational scale of work. The larger the scale, the greater the difficulties in implementing projects/programs or even in developing case studies due to the complexity of articulations between different countries/regions.

The following subsections indicate the main strategies adopted according to the scales and sectors of implementation for each of the three topics: climate change, nature-based solutions, and financing nature-based solutions. These findings were supported by the data obtained from the hearings and analyses of the associated documents, systematized in the analytical matrix. In the section on Discussion of the Theme "Water and the Environment" below, the main findings and trends based on the results obtained will be presented.

3.2.1 Climate change

After analyzing the selected material, 38 specific presentations on the topic of climate change were identified (Annex 3 – Presentations on climate change analyzed in the hermeneutics stage). In all, 12 (31.6%) presentations were identified as referring to mitigation strategies, 16 (42.1%) to presentations on adaptation and 10 (26.3%) addressing both strategies. Table 11 correlates the scale of work

(global/transnational, national and subnational/local), and the focus of action (mitigation and adaptation).

Table 11. Number of presentations on the theme of climate change classified according to the scale of work and the focus of action adopted (mitigation and/or adaptation).

Scale	Mitigation	Adaptation	Mitigation and Adaptation	TOTAL
Global/Transnational	4	3	2	9
National	3	7	3	13
Subnational/Local	5	6	5	16
Total	**12**	**16**	**10**	**38**

In all, 22 presentations with mitigation actions were identified, almost all of which were related to reducing emissions, and only one focused on carbon capture and storage. Sessions that involved ecosystem restoration actions and therefore carbon capture and storage were classified as nature-based solutions and will be described in the following subsection.

With regards to the sectors involved in emission reduction actions, up to two possible options were assigned among the 6 sectors identified as a response: waste treatment (50%), energy (28.6%), general (14.3%), land use (3.6%), and agriculture and industry. In only one presentation the sector of action was not described, while the sectors for which there was no mention were Agriculture and Industry. Considering only the 21 presentations focused on reducing emissions, in 7 of which there were two focus sectors, the total was 28 responses (Figure 3).

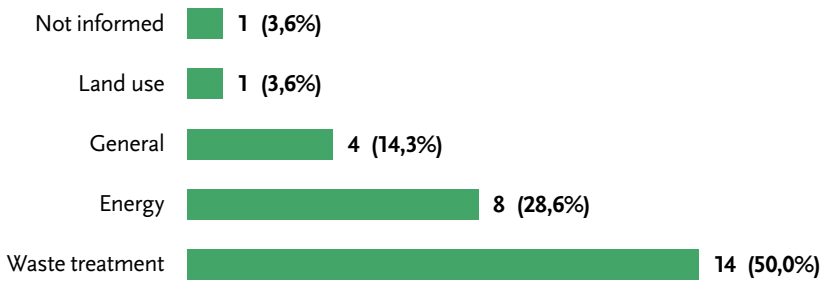


Figure 3. Distribution of presentations on emissions mitigation by sector activity (N=28).

Regarding the focus on adaptation, 26 presentations were identified as adopting strategies involved in the implementation of gray infrastructure, green/natural infrastructure, or a combination of the two. In all, 20 (76.9%) projects or case studies were identified with a focus on gray infrastructure, 5 (19.2%) with the use of both strategies, and only 1 (3.8%) with the exclusive focus on green/

natural infrastructure. The presentations focusing on green/natural infrastructure were classified for the most part as being related to the topic of nature-based solutions, following the same pattern adopted in the emissions mitigation strategy in relation to the topic of carbon capture and storage.

To identify the sectors in which adaptation strategies were implemented, up to three possible options were considered per presentation, with a total of 46 responses. Altogether, 11 sectors were delimited, of which 7 were mentioned during the presentations, in particular water resources (30.4%), infrastructure (23.9%), cities (13.0%), disaster risk management (10.9%), vulnerable peoples and populations (6.5%), agriculture (4.3%), and coastal areas (2.2%). There were four presentations in which a specific sector for the implementation of adaptation measures was not informed. The following sectors did not receive any response: biodiversity, industry and mining, food and nutrition security, and health (Figure 4).

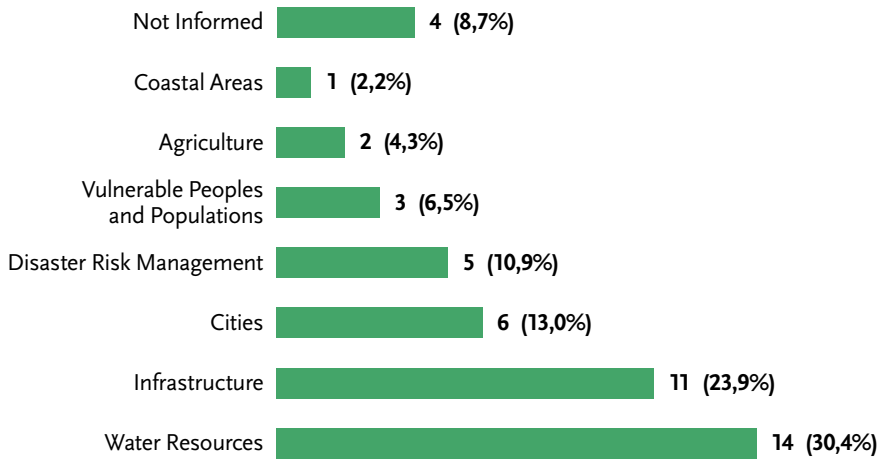


Figure 4. Distribution of the number of mentions of implementing sectors during presentations on adaptation to climate change (N=46).

In addition to analyzing the main strategies and sectors implementing mitigation and adaptation measures, the existence of some type of vulnerability assessment to climate change of a regional nature or in relation to local populations was also investigated. Besides vulnerability, it was also considered whether there were specific assessments of exposure and sensitivity, whose definitions can be found in Table 2, in the section on Background and context. A vulnerability assessment was carried out in 10 (26.3%) of the total 38 presentations. Of these 10, only three were also assessed for exposure or sensitivity, and in only one case were both assessments performed.

Despite the low number of mentions of vulnerability analyses, presentations on adaptation with a focus on vulnerable peoples and populations were identified. Considering the overlap between themes, these analyses also occurred in presentations classified as nature-based solutions, as discussed in the following subsection.

3.2.2 Nature-based Solutions

After analyzing the descriptive material for the selected sessions and listening to the audios of each one, 19 sessions on the topic nature-based solutions were identified (Annex 4), with 11 of these (57.9%) overlapping with the topic of climate change; these, however, were considered separately (Annex 3 – Presentations on climate change analyzed in the hermeneutics stage). As subtopics to NbS, the following activities were considered: conservation, restoration, and integrated landscape management (ILM). In addition to these activities, the results will also be presented for the categories used in climate change, but which are directly related to the topic, such as carbon capture and storage within the scope of emission mitigation strategies, and green/natural infrastructure, whether allied or not to gray infrastructure within the scope of measures to adapt to climate change. Several initiatives were related to more than one objective, in a manner consistent with the principles of NbS, which was previously presented in the section on Background and context.

Considering this overlapping focus of action, Table 12 shows the distribution of NbS presentations according to their scale of work (global/transnational, national and subnational/local) and overlap with the topic of climate change.

Table 12. Number of presentations on the topic of nature-based solutions according to the scale of work and its correlation with the axis of climate change.

Scale	NbS	NbS+CC	TOTAL
Global/Transnational	2	1	3
National	3	0	3
Subnational/Local	3	10	13
Overall Total	**8**	**11**	**19**

NbS = Nature-based Solutions | CC = Climate Change

Considering the overlapping focus of action (conservation, restoration, and Integrated Landscape Management - ILM) responses for the three categories were considered in their entirety, totaling 22 mentions from 13 (68.4%) presentations. The remaining 6 (31.6%) presentations that did not include actions in any

of the three foci concern adaptation actions with green/natural infrastructure and will be described separately. The presentations were classified almost equally in each of the three focuses of action (Figure 5). For 3 presentations (15.8%), actions were implemented across all three focus areas. Integrated Landscape Management presupposes the integration of restoration and conservation actions in an integrated vision for the management of the territory.

ILM = Integrated Landscape Management | Restoration = Restoration of Natural Ecosystems or New Ecosystems | Conservation = Conservation of Natural Ecosystems | Adaptation* = Use of green/natural infrastructure whether combined with gray infrastructure or not

Figure 5. Distribution of the number of mentions in the presentations of nature-based solutions in relation to the focus of action (conservation, restoration and ILM) (N=22).

With regards to environments for restoration and conservation actions, few presentations addressed this level of detail. Of the seven presentations referring to environments to be conserved, most concern actions carried out in forests (5; 71.4%). Riparian ecosystems and recharge zones were also mentioned in addition to rivers and tributaries, both with one response each (1; 14.3%). For restoration activities, the same number of responses was obtained, all of which referred to restoration in forest environments. This information reveals that there is a smaller focus on other environments such as mangroves, savannas, and wetlands.

With regards to the areas involved in the Integrated Landscape Management activities, a total of 17 responses were obtained in seven presentations since up to three options were considered for each case. Native vegetation (4; 23.5%) was the most frequent topic, followed by watershed management and production, both with three responses each (17.6%) - Figure 6. With this last option, production, the food, industrial and forestry sectors were considered, with each one mentioned once. One area that was not addressed as an integral part of ILM activities was the diversion of watersheds. The landscape elements most frequent in the ILM measures presented were a series of actions in the Forest, Water, and Soil environments, with 66.7% of the total of six responses.

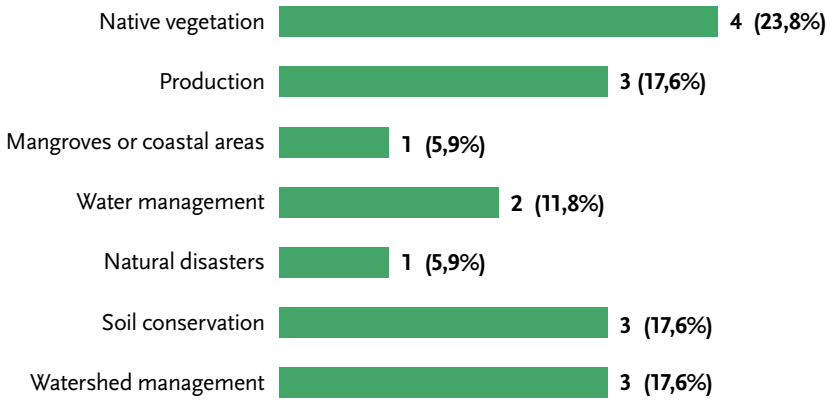
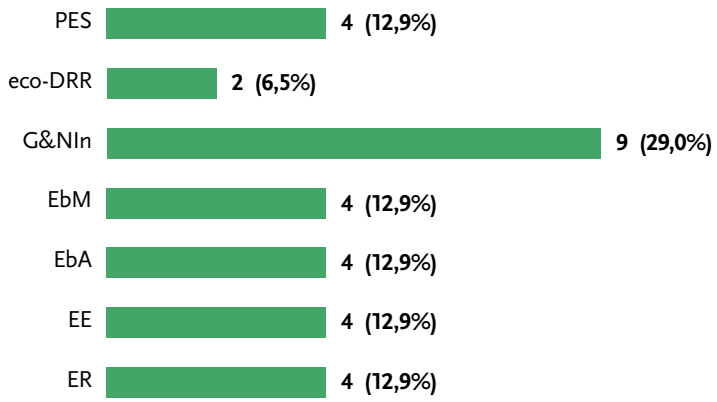


Figure 6. Distribution of the number of mentions of Nature-based Solutions presentations in the area of implementation of Integrated Landscape Management (ILM) activities (N=17)

Of the 19 presentations considered for NbS, 14 (73.7%) presented adaptation activities involving the implementation of green/natural infrastructure measures, whether allied or not to gray infrastructure (Figure 7). There is a prevalence of measures involving the implementation of green/natural infrastructure in a manner that is associated with gray infrastructure.

Figure 7. Distribution of presentations on nature-based solutions according to the adaptation measure implemented (N=19).

With regards to mentions of NbS in presentations, green/natural infrastructure (29.0%) was the most present in the material analyzed, while disaster risk reduction from ecosystem-based adaptation (2; 6.5%) was the topic that received the fewest mentions (Figure 8). The other identified approaches had the same number of mentions, with four each (12.9%).



NbS approaches: EcR = ecological restoration | EE = ecological engineering | EbA = Ecosystem-based adaptation | EbM = ecosystem-based mitigation | G&NIn = green/natural infrastructure | eco-DRR = disaster risk reduction through ecosystem-based adaptation | PES = payment for environmental services

Figure 8. Distribution of the number of mentions about the type of nature-based solution in the presentations assessed (N=31).

Although PES is not considered to be an NbS approach, it was considered for analysis on this topic as it is an important instrument for its implementation. Preliminary analyses of the material from the 36 selected sessions indicated the prominence of this type of instrument, thereby justifying its inclusion in the data. A more in-depth discussion of PES can be found in section 4.3 Financing Nature-based Solutions – Lessons learned and trends identified.

The NbS approach that gained most prominence at the 8th World Water Forum was green/natural infrastructure (G&NIn). Other approaches with an equal number of mentions included ecological restoration, ecological engineering, ecosystem-based mitigation and ecosystem-based adaptation, all of which received four (12.9%) responses. Less emphasis was given to disaster risk reduction through ecosystem-based adaptation (2; 6.5%) and restoration of landscapes and forests (no mentions).

3.2.3 Financing Nature-based Solutions

From the material submitted for hermeneutic analysis, 13 presentations were identified that addressed mechanisms for financing nature-based solutions (Annex 5). Of this set, nine were considered to be mainly focused on financing, while the others discussed NbS with mention of adopted financing mechanisms. Of the 13 presentations, nine (37.5%) presented financing actions for green/natural

infrastructure projects (G&NIn) or gray and green/natural infrastructure (GrayIn+G&NIn), eight (33.3%) included restoration projects (R) and seven (29.2%) conservation projects (C), with a total of 24 responses (Table 13).

Disregarding the overlaps of projects that had more than one NbS, as well as others that were presented more than once or that were case studies of the same project, 10 different projects were identified. The presentations were evaluated and from this total five projects were selected, presented in eight sessions, described below in the section 4 *Discussion of the "Water and the Environment"*.

Table 13. Number of presentations on NbS financing according to focus of action and scale of work (N=25).

Scale	G&NIn+GrayIn and G&NIn	Restoration	Conservation	TOTAL
Global/Transnational	2	1	1	4
National	4	4	3	11
Subnational/Local	3	3	3	9
Overall Total	**9**	**8**	**7**	**24**

Several cases were observed with more than one solution used, and for five (38.5%) presentations, funding was used for all three NbS strategies considered. There was no significant difference between the strategies, which shared very similar values. Most projects were carried out on the national scale of work (11; 45.8%). Global/transnational activities represented only 16.7% (4) of the total number of presentations analyzed, in line with the difficulty faced in mobilizing financial resources on a broad scale of work. Those activities identified are restricted to projects that operate in several countries and involve participation from several institutions, both public and private.

Regarding the analysis of the implementation model, 13 response fields were created, one of which was for cases in which the implementation was not specified, as well as another for other types in the form of an open field. Considering that it was possible to include up to three options per presentation, 20 identifications (Table 14) were obtained for the 13 evaluated presentations, and in one case the form of implementation was not specified. The following implementation options were listed but not found: environmental offset, performance contracts, bi- or multilateral cooperation, and donations/philanthropy.

Table 14. Types of NbS funding implementation models identified in presentations (N=20).

CODE	FORM OF IMPLEMENTATION	NO. OF MENTIONS
DB	Development Banks	4
BFS	Blended Finance Solutions	2
RBC	River Basin Committees and similar entities	2
TI	Investment funds for socio-environmental impact	5
PVI	Private investment	1
PBI+PVI	Public and private investment	3
PPP	Public-private partnerships	3
	TOTAL	**20**

Despite the possibility of filling in more than one option, in only three cases were three forms of implementation presented. The presentation cases regarding *blended finance solutions* were associated with the presence of public-private partnerships as the main source of financial resources. The most common implementation was investment funds for social and environmental impact (25.0%), followed by development banks (20.0%) and public-private partnerships (15.0%). The least used form of implementation in the evaluated sessions was private investment (5.0%).

With regards to financing mechanisms, three different approaches were considered: environmental compensation (*offsets*) (EC); tax incentives (TI); and payment for environmental services (PES). The distribution of presentations according to the mechanism applied and the work schedules is described in Table 15.

Assuming the likelihood that more than one mechanism could be used, possible combinations between these mechanisms were also considered, resulting in seven possible response options. In addition to these options, in two presentations (15.38%) the type of model was not specified. In the remaining 11, the most used mechanism was PES (6; 46.15%), as a single mechanism, followed by the mixed option of TI + PES (3; 23.07%). PES therefore represented more than half of the total mechanisms employed, indicating a wide adoption especially at the national and subnational/local scale of work.

Table 15. Number of presentations on NbS funding according to scale of work and the funding mechanisms implemented.

Scale / Mechanism	No. of presentations
Global/Transnational	**2**
EC	**1**
PES	**1**
National	**5**
PES	**2**
TI+PES	**3**
Subnational/Local	**4**
PES	**3**
FI+EC	**1**
Not specified	**2**
OVERALL TOTAL	**13**

EC = Environmental Compensation (Offset) | TI = Tax Incentive | PES = Payments for Environmental Services

In addition to implementation mechanisms and models, the objectives of the NbS financing actions adopted were also considered. Ten categories of objectives were considered, from which up to three options could be selected, with a total of 32 responses (Table 16). Of the 10 possible objectives, three were not selected: microfinancing for water management services, funding for research and development of new technologies, and implementation of water reuse and treatment systems.

Table 16. Types of objectives of financing actions adopted for NbS (N=32).

Objectives	No. of responses
Management and conservation of watersheds	**9**
Protection of springs and water sources	**7**
Conservation of remnants of native vegetation	**3**
Restoration of native vegetation	**4**
Soil conservation	**4**
Gray infrastructure	**4**
Mitigation and adaptation to climate change	**1**
OVERALL TOTAL	**32**

The main objective of financing activities in the analyzed presentations was the management and conservation of watersheds, representing more than a quarter of the mentions. This was followed by the protection of springs and water sources, with 21.2% of the total. The focus on conservation and restoration of remnants of native vegetation was also well represented and was often allied to the objective of mitigating and adapting to climate change, given their frequent association.

4. Discussion of the theme "Water and the Environment": Lessons learned and trends highlighted

Through means of hermeneutic analysis of the selected sessions, in addition to the identification of patterns presented in the section 'Results', it was possible to identify the main information of each presentation regarding the proposed overarching themes: research and innovative technologies, education and training, and recommendations.

The discussion of the information also made use of external references, if applicable, including publications and websites referring to the presentations, in parallel with a partial assessment of literature relevant to the topics analyzed. The main trends were observed and possible findings and opportunities were identified on the three topics analyzed: climate change (CC), nature-based solutions (NbS); and financing nature-based solutions.

4.1 Climate Change (CC)

In addition to the trends uncovered within the topic of climate change determined through hermeneutic analysis of the selected sessions, the relevant innovations and lessons of the experiences presented were also recorded and described in the sections below according to the main measures implemented, taking the existence of overlap between them into consideration. Key education and training highlights for each topic have been compiled and described at the end of each section.

4.1.1 ER – Emission Reduction

With regards to mitigating climate change by reducing GHG emissions, there is a growing understanding that the water sector offers an important potential for reducing emissions through increasing the efficiency of transport processes and of wastewater treatment, as well as a more holistic view and management

of water cycles, including their vulnerability and impacts on climate change. In the sessions in which these topics were addressed, the benefits of promoting a circular economy were highlighted, aiming to eliminate the generation of waste through a closed system of recycling, recovery, and reuse.

Proposals were identified that aim to make more efficient and integrate processes of wastewater reuse and treatment with energy generation provided through multipurpose gray infrastructure, integrating water use, and energy generation, as well as water treatment plants that aim to recover resources from the waste generated.

Examples include Japan which, during the presentation made by the *Japan Sanitation Consortium*, was highlighted as one of the world's leaders in the initiative to avoid energy "waste" during the treatment of wastewater alongside similar projects in France such as the public health agency Paris Sanitation Department (or SIAAP, the corresponding acronym in French), which currently has seven carbon recovery projects underway at its treatment plants. In this last example, energy is generated from the sludge remaining from the city's treatment process, equine manure, and organic waste and is used both for the internal use of the stations and for public use, such as in vehicles through the liquefaction of the generated biogas. Another French case, presented by the Water Company of Marseille, indicated that the city's water service network supplies 1.8 million people and that currently 96% of the energy used comes from renewable sources provided by 400 m² of photovoltaic panels. More information about the project is highlighted in BOX 1.

One of the main difficulties in the development of climate change mitigation projects is the concern of decision makers with regards to the investment needed to make a transition to low carbon systems. The event's speakers all emphasized during their presentations that, when considered from a broader, longer-term point of view, low-carbon services and models can be more efficient and effective, and the issue of cost and financing is often a false issue. But this change in perception can only be achieved with more integrated, multisector public policies designed with the help of decision makers, industries, legislators, researchers, and society. The systematic adoption of cost-benefit assessments of business models and public policies based on the internalization of environmental costs as part of

BOX 1. OS-TP-08
How to promote sustainable water services: the case of Marseille, France

Marseille Water Company

This Marseille-based agency is seeking to achieve sustainability and carbon neutrality through environmentally responsible water and sanitation services. To achieve these goals, 4 sustainability principles are followed: energy management with GHG emissions assessment, an environmental management system, local and international solidarity, and the sharing of transparency and governance.

For more information:
<www.eauxdemarseille-environnement.fr>

ENGLISH

natural capital – alongside human, material and financial – is an approach to objectively support these decision processes.

4.1.2 CCS – Carbon Capture and Storage

Due to the overlap between Nature-based Solutions (NbS) and Climate Change (CC) mitigation, categorizing the presentations proved to be complex. In the case of those related to carbon capture and storage, the examples cited all involved a land use dimension. In other words, the associated initiatives had an ecosystem restoration component that, in addition to being an NbS initiative, also promoted carbon sequestration. In order to not dilute and decentralize results, the presentations in this category were addressed in the subsection EbM – Ecosystem-based Mitigation of section 4.2 Nature-based Solutions (NbS) – Lessons learned and trends identified.

Carbon capture is not only carried out through changes in land use and there are technologies available for capturing atmospheric carbon or capturing carbon directly at the source of emission, such as in industrial processes. Examples of these other approaches were not found in the analysis performed.

4.1.3 GrayIn - Gray Infrastructure

Gray infrastructure in water management models is often a topic of discussion with regards to its long-term sustainability. Even though the presentations analyzed showed a consensus on the need to develop more green/natural infrastructure, it was also shown that gray infrastructure is necessary in some cases and that the use of mixed solutions should be encouraged, whenever possible, considering the potential to renew existing gray technologies, making them more effective through the promotion of more sustainable results in environmental terms.

In the presentations on gray infrastructure, a great deal of emphasis was placed on technological solutions such as the Serre-Ponçon dam, presented by the International Office for Water (IOWater), which, because it is built on land, does not suffer deformation as a result of earthquakes. Also in the same presentation, the case of a hydroelectric plant that follows the banks of the river was described, moving up and descending slopes, generating energy through natural gaps of 15 to 20 m.

To enable or increase the effectiveness of certain adaptation projects through gray infrastructure, the use of aquifer sensing and modeling technologies and particle tracking were also mentioned.

BOX 2. OS-TP-35 Disaster prevention and reduction in vulnerability

Humanitarian Colombia, National Unit for Disaster Risk Management (NGRD) and the Adaptation Fund

The Adaptation Fund and other entities were created after the serious floods caused by the La Niña phenomenon, which occurred in Colombia in 2010 and 2011. The Fund's objective is to promote the development of gray infrastructure that take CC and extreme events into consideration in order to prevent losses. The Fund currently promotes the development of four macro projects to adapt to CC and prevent disasters. In addition to these projects, the creation of the municipality of Gramalote, the first municipality of the 21st century adapted to climate change, stands out. In addition to the construction of houses, schools and aqueducts, the Fund uses a methodology known as FEDESAROLLO to determine the vulnerability of families and seek out actions to reduce it.

For more information

<ttp://sitio.fondoadaptacion.gov.co>

One tool found by the Colombian government to deal with the consequences of climate change, such as extreme weather events, was the creation of a fund to promote the development of gray infrastructure. BOX 2 provides further information about the case.

Another relevant proposal presented by the US Army Corps of Engineers, in the southern United States, involves the idea of adaptive implementation. Due to the lack of immediately available funds for building infrastructure at the scale necessary for dealing with future problems linked to extreme weather events and the respective uncertainties linked to the impacts of climate change, the approach focuses on solving problems faced in the near future. Excessive investment is therefore avoided, but it already allows for the acquisition of the land needed to gain scale, ensuring more affordable prices and solving potential governance difficulties that could arise in the future. The idea is therefore to implement the necessary and appropriate measures within the respective budget, adapting to the reality and context of that moment.

It is worth noting that The US Army Corps of Engineers is an organization that builds both military and civil public infrastructure in addition to acting as a water resources agency. The situation in the city of New Orleans, for example, is one of vulnerability to extreme weather events that can cause flooding. In this regard, the objective is to propose adaptation measures that will not subsequently be a source of regret. The US Army Corps of Engineers worked to build infrastructure that would make room for the river to expand into its floodplain, controlling water storage areas, and creating drainage systems through other rivers. This is a self-adaptive solution that allows greater, more accurate, and effective control of floods using spaces that can also be used as leisure areas. In addition, the Army Corps help pay for the relocation of people with homes in risk zones or the elevation of these homes to protect them from flooding.

With regard to trends, a recurring recommendation among the speakers was the need to promote greater communication, coordination and cooperation to

ensure integration in water resources management aimed at sustainability and water security over the long term. This applies both in situations involving multinational rivers and basins and in the raising of awareness within communities, including all stakeholders in decision-making processes (communities, NGOs, the private sector, governments, etc.), involving policies related to water use and the regulation of related activities.

Another important recurring recommendation was the need to move forward with solutions that have already recognized and are adapting to extreme weather events, whether they involve droughts or floods. Current regulatory scenarios still involve difficulties in adapting to the variability associated with forecasting climate change and its impacts, and in promoting vulnerability assessment and risk reduction measures.

4.1.4 Highlights in training and education

The topic of climate change mitigation revealed that education and training are needed across all scales, from the international to the individual level and, in the individual case, can be developed for all ages. Greater effectiveness of initiatives aimed at adapting to climate change can be ensured through education and training provided at all levels. Education must cover all ages and levels of training, from elementary school to universities, not only to raise general awareness of gender issues, community management, and the environment, but also to open the door to the implementation of bottom-up projects, in which decision-making is based on the demands of the community itself. Presenters from around the world emphasized that a shift in paradigm will only occur with the education of young people.

Lack of knowledge is often associated with the insufficient access to information, which thereby generates distrust. Many organizations therefore promote transparency and governance policies, integrating society through means of mitigation activities.

Education can also serve to create motivation, and motivation leads to access to resources. Some organizations are assisting in the preparation of CC mitigation and adaptation plans, organizing seminars with companies responsible for the management of water resources, such as the Green Climate Fund (GCF) which, having noticed a lack of climate change projects linked to water, has provided training to national organizations responsible for water management on the design, planning, and execution of projects using its resources.

Training places value on local experiences through the exchange of lessons learned, for example between government officials and water resource agen-

cies as seen in the project on water scarcity management in the Durance and Verdon river basin (Provence, France). It also allows the sharing of experiences with Brazil, as seen in the case presented by the Marseille Water Company, highlighted in BOX 1.

4.2 Nature-based Solutions (NbS)

In this section, innovations identified in the experiences related to the theme of Nature-based Solutions (NbS) subject to hermeneutic analysis will be presented in accordance with their respective approaches: ecological restoration, ecological engineering, ecosystem-based mitigation, green/natural infrastructure; as well as a subsection focused on payments for environmental services. The main trends identified in the NbS approaches highlighted in the analyzed Forum sessions will be discussed. Finally, highlights from the overarching theme of education and training referring to the theme as a whole will be presented. The definitions of the approaches presented in the following topics can be found in Table 3 – Definitions of primary approaches characterizing nature-based solution interventions.

4.2.1 EcR – Ecological restoration

As a rule, Ecological Restoration (EcR) projects are implemented in association with other NbS approaches – with emphasis on Green or Natural Infrastructure (G&NIn) and Ecosystem-based Mitigation (EbM) –, as well as serving as an economic instrument for Payments for Environmental Services (PES), reinforcing the concept that restoration generates multiple benefits and responses to current social and environmental challenges.

An example of a project whose implementation involved G&NIn approaches together with EcR, is the Water Landscapes program presented by the University of Plata (Argentina). The program aims to identify natural systems in order to imitate and multiply them to increase resilience to climate change. Green infrastructures are built to remove excess nutrients to prevent them from reaching water bodies, through the creation of a natural filtration system provided by the EcR found in the respective areas, thereby promoting more resilient systems. A recommendation made in this presentation was to include elements of eco-hydrology and green/natural infrastructure in engineering course curricula.

An example of a project that integrated the EbM and EcR approaches was the Flood Management Program implemented by Senegal's Ministry of Urban Development. The program integrates urban planning, housing for people in need

and water reuse. The program is supported by the Green Climate Fund, which will be described in more detail in section 4.3 Financing Nature-based Solutions. Vulnerability reduction is pursued through the integration of water-related policies, improving knowledge about flood risks and anticipating such events.

Two major trends are noticeable in EcR approaches: a) Integrating the action of restoring degraded ecosystems into broader concepts such as Green/Natural Infrastructure and Ecosystem-based Mitigation; and b) Recognizing and rewarding rural landowners, producers of benefits from nature for people, through PES mechanisms.

4.2.2 EE – Ecological Engineering

The ecological engineering methodology addresses environmental issues by employing ecological practices to overcome challenges such as wastewater treatment, recycling, and pollution issues. Closely related to ecological restoration, it was observed that the vast majority of initiatives related to this approach were associated with other NbS approaches, such as green/natural infrastructure, indicating a synergy in the application of different NbS methodologies. A predominance of local work scale projects was also observed for this NbS approach – the presentations analyzed in relation to this approach referred to projects or case studies carried out at a local scale.

The Women, Water and Work Campaign presented by the Self Employed Women's Association (SEWA) works in partnership with the WASH (Water, Sanitation and Hygiene) program developed by the United Nations (UN) and is an example of a project involving the implementation of the ecological engineering approach together with ecological restoration. SEWA is the largest national union of informal workers in India and works to promote job, social, and income security for the organization's 1.34 million members. In addition to introducing a strong and important gender approach in the projects developed, including a criterion of at least 50% participation from women, they developed an interesting strategy for financing and developing ecological restoration projects and the installation of small-scale sanitation structures. The projects aim to stimulate local entrepreneurship using a model in which local communities act as owners and assume responsibility for water resources and their management. Community WASH committees are organized that meet regularly and disseminate knowledge. They aim to establish agreements with the state through long-term partnership models rather than short annual contracts, in addition to local capacity development and community awareness with the involvement of NGOs and other stakeholders in the water sector.

BOX 3. OS-RP-30 Quito Environmental Sanitation Program: Phases I and II

The Metropolitan Public Company for Potable Water and Sanitation in Quito

Faced with the difficulties caused by uncontrolled urban sprawl, the local government has developed programs and projects aimed at controlling floods through green infrastructure, in order to guarantee water security in Quito, Ecuador. Vulnerability, exposure, and sensitivity assessment studies were carried out to guide decision-making. Projects use a scoring system to determine priority actions. Work is carried out with the local community at all stages of the project, as well as training is provided to municipal officials in the application of a risk assessment methodology.

For more information:

<https://publications.iadb.org/publications/english/document/Successful_Case_of_Change_Management_toward_Business_Sustainability_First_Whole-cycle_Implementation_of_AquaRating_in_The_World.pdf>

Innovations in this type of approach that were considered included: small-scale action with community involvement, highlighted by the WASH project and an initial approach to the NbS Green/Natural Infrastructure (G&NIn/NatInf) and Ecosystem-based Adaptation (EbA) approaches. Therefore, the Quito Environmental Sanitation Program – Phases I and II (highlighted in Box 3) – developed in the capital of Ecuador, was able to innovate by evaluating and recognizing natural areas as green flood control instruments. In the same vein, the government of Madrid, Spain, in a presentation on the case study of the implementation of the Canal de Isabel II in the city, invested in the recovery of riparian areas as an instrument for adapting to flood scenarios predicted as a result of climate change, using logic involving a transition from gray infrastructure to green/natural infrastructure. Additionally, several mathematical models for the prediction of extreme events were presented in order to encourage the adoption of the Ecological Engineering - EE approach.

Another project that adopted EE as a primary methodology was the project developed by the Center for Community Consultation on Social Utilities Technologies (Cactus) from the Federal Institute of Paraíba, which promoted the application of evapotranspiration tank technology to sewage treatment in the state's semi-arid regions based on community management. This strategy circumvents the low availability of water in the region, in addition to being a low-cost option that is accessible under the region's economic and social conditions. During the implementation of this project, to bridge the parameterization gap, an equation was developed that took information regarding population, area and resources into consideration in order to not overestimate the size of the project needed to be implemented and to account for the specific demands of the project location. This strategy is analogous to the adaptive implementation presented by the US Army Corps of Engineers, and described in the section GrayIn – Gray Infrastructure.

Finally, in addition to sewage treatment techniques, wastewater storage and the construction of wetlands are also worth mentioning. A recurring and impor-

tant recommendation on the EE approach in the lectures analyzed is the need to bring NbS closer to civil, sanitary, and water engineers, so that green and gray infrastructure can be integrated. Conducting vulnerability assessments and adaptation studies were indicated as being urgent, as was the need for appropriate information on the multiple benefits of ecosystem restoration.

4.2.3 EbM – Ecosystem-based Mitigation

During the sessions measured, EbM presented itself as the most universal approach in the sense of coordination with other NbS. It was present in projects of all scales of work (global/transnational, national and subnational/local) and types of presentation (Conceptual, Case Study and Program/Project) analyzed. In this manner, it was proved to be capable of expressing multiple interests in the construction of adapted and effective strategies to face social issues related to water security.

The Japan Forestry Agency presented its experience with using LIDAR (Light Detection and Range) technology to monitor forest biomass in watersheds, improving decision-making capacity on investments in restoration of degraded areas, and the maintenance and monitoring of existing and recovered forests (see BOX 4). Within the scope of the Pride for Water project developed in Colombia, a set of training, social communication, and dialogue facilitation actions was able to reverse the decision-making logic from top-down to bottom-up, empowering and engaging the social actors involved and, consequently, strengthening the integrated management model adopted for the watershed.

The trend, and recommendation, observed for EbM approaches is to invest in capacity building, training and social communication as a strategy to increase social participation in decision-making in the allocation of public resources for water resources management. Emphasis was also placed on the need for a more holistic and integrated approach to water resources management, including three main aspects:

BOX 4. OS-TP-47
Forest and water resources management with the use of technologies

Japan Forestry Agency

Data on forest plantations in Japan, collected over 100 years, reveal the importance of forests in protecting against erosion and flooding. Forest management aims to revitalize watersheds, and management is carried out with the help of two tools: 1. Ecosystem-based Disaster Risk Reduction (Eco-DRR); 2. Light Detection and Range (LIDAR) – for estimating the conditions of the forest environment through remote laser sensors. Both measures have supported the development of water availability management and simulation scenarios.

To learn more about these technologies, access publications on Eco-DRR, in Portuguese and LIDAR, in English.

<http://www.editora.ufc.br/images/imagens/pdf/geografia-fisica-e-as-mudancas-globais/1334.pdf>
<https://portals.iucn.org/library/sites/library/files/documents/2017-045.pdf>

ENGLISH

- *Sustainable financing;*
- *Community engagement; and*
- *Strengthening governance models and policies that encourage social participation.*

4.2.4 G&NIn and GrayIn – Green/Natural Infrastructure and Gray Infrastructure

The Green/Natural Infrastructure (G&NIn) approach was presented in projects on both the topics of Climate Change and NbS. In order to better present the information, they were all compiled into this section, the results of which are described below.

A predominance of application of this approach at the local work scale was observed, which was also related to EcR. The institution that most presented projects related to this approach was The Nature Conservancy (TNC), followed by regional development banks and funds (such as IDB, AFD, FONAG and others) and public institutions and companies.

The World Resources Institute (WRI) - Brazil and partners worked on the application of natural infrastructure in the water reservoirs in Cantareira/SP, Jucú/ES, and in Guandu/RJ (although the latter was not presented, the report available on WRI-Brazil's webpage was accessed) through means of restoration projects. A methodology for evaluating the impacts of investment was applied, which is described in more detail in BOX 5.

BOX 5. OS-CF-04
Natural water infrastructure: Cantareira and Jucú Systems
World Resources Institute (WRI)

The projects for the application of natural infrastructure in the water reservoirs in Cantareira/SP and Jucú/ES are aimed at restoring degraded areas in order to improve the water security of large metropolises in the face of increasing periods of drought, in addition to reducing costs associated with dredging and water treatment. The evaluation follows a methodology that includes modeling of results (estimates), valuation of return on investment (ROI), and assessment of risks and uncertainties.

For more information, access the publication on the case of Cantareira/SP in Portuguese.

In the presentations involving G&NIn approaches, it was possible to observe the prevalence of adaptation activities that make use of these methodologies, as well as their implementation in association with gray infrastructure. This result is reinforced by the predominance of climate change presentations whose focus centered on gray infrastructure, demonstrating a tendency to use both strategies in a complementary way and to overcome mutual limitations, adapting to different contexts and needs and promoting benefits that were both ecological and economic in nature.

Two of the main presentations that cited potential innovations in green/natural infrastructure dealt with constructed wetlands (CW) – wetlands

developed to improve the natural ability of these ecosystems to filter water resources. The first case was presented by the National Water Research Center in Egypt, in which the construction of wetlands in 2001 was combined with fish farming and agriculture, optimizing the economic potential of this strategy. The other presentation on CW was made by the Mexican Institute of Water Technology (IMTA), in which the use of bioindicators for monitoring the environmental quality of water was presented, aiming at its improvement through the implementation of this technology.

Certain green/natural infrastructure solutions, such as forest restoration, require specific management processes. Unmanaged or poorly managed forests may compromise the potential benefits of water resource management. Conversely, proper management can also represent social and economic opportunities such as generating employment and income through agricultural, agroforestry, timber, and non-timber products within the forest industry, in addition to promoting integrated landscape management.

Even with the support of several institutions and moving resources to develop concrete actions, the G&NIn approach still lacks better data, especially in terms of technical-financial modeling. Long-term follow-up of the implementation processes of these solutions is also necessary to provide leverage for increasing the scale of investments as part of this agenda. The trend observed through the analysis of the sessions is that this approach increasingly occupies discussions on planning and investment related to the storage and distribution of water in large urban agglomerations. It is therefore necessary to expand the set of evidence demonstrating the relationship between cause (increased investment in G&NIn) and effect (improvement in efficiency in the water resources management process). In addition, it will also be necessary to invest in carrying out traditional cost-benefit assessments for public policies for the promotion of G&NIn and in training and informing decision-makers on the subject based on the results obtained in case studies.

With regards to the trends and recommendations highlighted for this approach, the following items were mentioned: the need for a holistic and integrated approach that promotes the dissemination of the benefits of green/natural infrastructure in adapting to climate change, and the need to promote the coordinated adoption of green and gray infrastructure in order to achieve different goals in different contexts.

Since approaches using green/natural infrastructure or gray infrastructure are independently recognized, the focus on implementing approaches that integrate these two forms of infrastructure is essential for optimizing their functioning, taking advantage of the strengths of each through, for example, the creation of partnerships and the adoption of best practices.

BOX 6. OS-RP-30 Integrating green and gray infrastructure

Inter-American Development Bank (IDB)

Faced with the need to incorporate green and gray infrastructure practices, the IDB developed tools to facilitate this integration. HydroBID is an integrated system for simulating the impacts of climate change on water resources with a focus on Latin America and the Caribbean. RIOS is a spatial modeling tool that aims to optimize investment in watersheds in order to obtain multiple benefits.

For more information, access the IDB presentation available in pdf.

<https://conference.ifas.ufl.edu/aces18/Presentations/Salon%20C/Tuesday/1020%20Munoz%20Castillo%20-%20Y.pdf>

In a presentation made by TNC on the need to promote green infrastructure, it was emphasized that investment in green/natural infrastructure to achieve water security and resilience around the world will be indispensable, but that this infrastructure alone does not serve as a guarantee in achieving these goals. Synergy with gray infrastructure is therefore necessary. As part of the same session, during another presentation made by the Inter-American Development Bank (IDB), it was pointed out that an opening for the use of this new mixed approach will have to come from classical engineering for this integration to actually take place. More information about the presentation made by the IDB is featured in BOX 6.

4.2.5 PES - Payments for Environmental Services

The PES economic instrument was addressed in several lectures related to NbS approaches. Although it is not an NbS approach per se but rather a financial mechanism, PES was highlighted in this section in order to present relationships existing with other NbS. More details regarding the topic of NbS Financing will be presented below in section 4.3 Financing Nature-based Solutions – Lessons learned and trends identified.

The approaches that were most related to this instrument were EcR and G&NIn. The majority of the institutions engaging with this theme are Brazilian; therefore, it did not receive much emphasis on the global scale of work during the 8th World Water Forum.

From among the initiatives presented, the Water Producer Program, which is promoted by the National Water and Sanitation Agency and is implemented in many watersheds distributed throughout the Brazilian territory, stands out, as does the Pipiripau Project, coordinated by Adasa in the Federal District, also presented during the Forum. Under this Project, around 200 of the 600 rural producers in the basin receive PES for good practices and environmental recovery or conservation activities implemented on their properties (G&NIn + NbS and others).

The Oásis Project in São Bento do Sul/SC, was presented by the Boticário Foundation and receives participation from 17 landowners in an area corre-

sponding to 10% of the basin, with the implementation of PES in a 3,239 ha area, with the additional conservation of 16,223 ha through restoration. The project's objectives include: the enhancement of natural environments, encouraging nature-based solutions through means of financial incentive mechanisms and acceleration processes, the maintenance and improvement of environmental services provided by properties, activities carried out on a national scale through partnerships and collaborative networks, enhancing opportunities for new business models, and promoting well-being.

Few innovations were presented on this topic, which has been widely disseminated by different projects and on many scales throughout Brazil. A highlight is the rearrangement of the governance model suggested by the Sustainable Amazon Foundation (FAS). As part of this rearrangement, the effective management of projects in the context of the Amazon Basin, considering its size and transboundary characteristics, requires a different model from the traditional basin committees in order to be able to act in the management of water use conflicts. It is then necessary to implement micro basin committees and provide a focus on the importance of management to maintain the abundance of existing water.

Another innovation, on a more social level, but with positive consequences for conservation, was presented by the NGO RARE with regards to the implementation of its Pride for Water project in Colombia. The innovation lies in the logic of awareness, in which the project aims to engage farmers to ensure that they understand the importance of conserving the basin and choose to change their production practices over the long term, motivated by interests that go beyond simple financial compensation.

A trend observed in presentations on PES was the need for greater coordination with regards to the issue of gender, as it was not a topic addressed to the same extent as in other presentations. Another lesson learned is the need to structure continuous training strategies, especially in best agricultural practices and waste management. An interesting example in this regard was that provided by the WASH project implemented by SEWA, which promotes regular meetings for the dissemination of knowledge, presented in the section EE – Ecological Engineering.

4.2.6 Training and Education

With regards to the proposals presented for the overarching axis of training and education, it was observed that this is a prevalent theme in actions that involve community participation as part of their implementation and management activities. Recommendations in the sense of offering qualifications

and training, often in a continuous manner, were recurrent and represent an important EcR strategy for 40% of the programs/projects on this theme. Although community training and social communication were mentioned in the EE presentations, what prevails in this approach is the training of public agents, operators and companies specialized in the subject.

The transition from gray infrastructure to green/natural infrastructure, or a combination of both, can be reinforced by including elements of eco-hydrology and NbS in the academic curricula of engineering courses, for example. Within the professional sphere, the importance of bringing NbS experiences closer to civil, sanitary, and water engineers was highlighted. It is worth noting that this topic was rarely mentioned in the presentations on the G&NIn approach. Despite the importance of the discussions about incorporating G&NIn concepts into engineering curricula and related activities, as well as the relevance of environmental education as a way to change mental models and established paradigms, the references used were brief citations that did not offer in-depth perspectives.

Another trend observed was the use of awareness campaigns involving social communication, such as campaigns aimed at direct beneficiaries, influencers, and decision makers. In the Pride for Water project, developed by the NGO RARE in Colombia, whose main approach was EbM, the main concern was identifying the common interests between different social actors in order to create a vision for the future, strengthening the sense of belonging to a specific territory. In this manner, it was possible to keep the actors engaged in the construction of proposals for the problems identified.

Education and training also need to recognize the constant changes in the current scenario due to climate change. In Quito, Ecuador, this manifested itself through the training of local government officials in the application of risk assessment methodologies.

The issue of awareness was also addressed, and the socio-environmental marketing carried out used various means of communication to encourage changes in behavior. Pride for Water's theory of change followed the logic presented in Figure 9.

Actions to raise awareness and engage rural producers were highlighted as fundamental by most of the experiences discussed in relation to PES instruments. However, little detail has been provided on this topic.

All presentations on the adoption of green/natural and gray infrastructure in adapting to climate change emphasized the need for local involvement beginning with the program's design phase. Since it frequently adopts innovative techniques, Quebec's Rés-Alliance initiative, in addition to involving local com-

munities, also promotes the sharing of experiences among watershed management organizations, encouraging the formation of communities of practice. This integration also helps to overcome social, educational, and cultural differences, increasing the involvement of communities, particularly rural ones, with intuitive and practical knowledge about local ecosystems. An important focus of this work is to foster a sense of civic obligation and local mobilization as the main tools used in Integrated Water Resources Management.

In the following section, the main cases presented regarding the topic of financing Nature-based Solutions will be described.

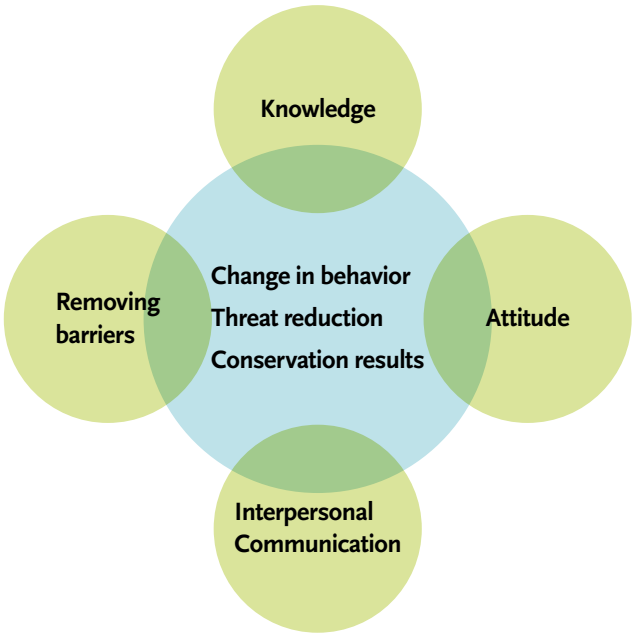


Figure 9. The theory of change adopted by the Pride for Water project.

4.3 Financing Nature-based Solutions

The Financing of Nature-based Solutions (NbS) is still a very undeveloped topic and area of study in which formulation and consolidation has taken place in recent years. The reduced number of presentations (13) that addressed this issue during the 8th FMA makes this evident. In addition, it was possible to observe that the description of the financing mechanism and the implementation models adopted were not the main focus of the presentations that addressed the

subject. The topics of mobilizing financial resources to accelerate the transition from gray to green/natural infrastructure models and for NbS adoption were generally approached marginally.

With regard to the different forms of implementation, in few projects were more than two implementation models integrated. Among them are the only two cases of river basin committees and similar entities, which were associated with development banks and public and private investment. In these examples, the need for support to the committees was highlighted not only from local governments, but also from stakeholders (private investments) and development banks, which are capable of raising larger amounts of resources. The presentation cases regarding blended finance solutions were associated with the presence of public-private partnerships as the main source of financial resources.

4.3.1 Financing of initiatives in watersheds

Regarding information related to financing mechanisms aimed at the management and conservation of watersheds, whether such mechanisms involve NbS, the Water Funds mentioned in the following subsection were described in the presentations as instruments capable of generating sustainable long-term financing based on the management of investments and their yield. The recurring fundraising strategy consisted of private and public contributions from associated parties necessary to implement projects from a broad portfolio of investors. In addition, some presentations mentioned microfinance schemes and the need to combine green/natural infrastructure with conventional solutions (gray infrastructure) so that greater value can be generated for the entities receiving the facilities in the basins.

On the global/transnational scale of work, cooperation agreements for large multinational rivers/lakes/seas/aquifers should be encouraged, involving strategic planning, and the design of fundraising programs to carry out actions at the watershed level. Highlights of this type of agreement were made by the IOWater (International Office for Water) projects in Africa and Indonesia, the Orange-Senqu River, Water for Africa and the Colorado River case study, involving an agreement between Mexico and the United States. The optimization of joint planning depends on the alignment between political will and a shared vision for economic integration, thus making it possible to implement financing models for NbS projects with the generation of lasting and beneficial results for all parties.

The adoption of PES practices, tax incentives, charging for water use or benefits to producers who adopt good land use practices were extensively addressed

in the presentations analyzed. In these cases, environmental education is fundamental to guarantee that the investments being made will be maintained by the population, as they understand the importance of conserving that resource.

In short, the models for financing watershed conservation involved: public-private partnerships, blended finance solutions, socio-environmental impact funds, development banks, and private investments.

4.3.2 Main highlights

In this section, the cases chosen from among those described during the evaluation of the material from the 8th Forum sessions will be presented. The number of presentations referring to the topic of Financing of NbS was relatively small, corroborating what was already expected after the quantitative analysis of the data in which the sessions that contained the key terms of NBS Financing represented only 6% of the total sample. Considering that the qualitative analysis makes it possible to better select the cases to be analyzed, it was possible to reach the value of 13.6% of presentations included under the prism of NbS Financing. To overcome the lack of detail in the mechanisms, due to the limited time for presentations, the main trends and recommendations will be highlighted from the cases in which there was a clear presence of a financial arrangement or payments for environmental services.

Water Funds

In 2011, the Latin American Water Funds Alliance was created, comprising the Global Environmental Fund (GEF), the FEMSA Foundation, The Nature Conservancy (TNC), and the Inter-American Development Bank (IDB) to promote water security in Latin America and the Caribbean through the creation and strengthening of water funds. An institutional financial mechanism was established to support joint action between the public and private sectors and the implementation of green/natural infrastructure, with each water fund supported having an autonomous committee and an executive secretariat. The Alliance's financial mechanism relied on US$ 15 million at the beginning of its implementation, with more than US$ 150 million being leveraged through private or public contributions. A donation of 5 million euros was also made by the German government in addition to a contribution of more than 2 million dollars from the GEF.

The instruments associated with the constitution of Water Funds were discussed in several presentations distributed across two different sessions at the

Forum. Its adoption on a multinational scale in Latin American countries has taken place as a response to the current scenario of climate change added to difficulties in the management of water resources. These initiatives have been organized under a new model of network between the funds, so far including 23 funds implemented in 8 countries.

The financing approach proposed by these funds follows a logic of flexibility with different sources: private, public, multilateral/bilateral, NGOs/foundations and public utility companies. Governance models vary between each fund, exploring different arrangements for the composition of funding sources. These funds require efficient administration since they are complex systems acting within the entire institutional and financial context of the watersheds that guide the implementation of actions, which are both gray infrastructure and innovative NbS projects, such as those involving green/natural infrastructure.

The Fund's actions involve working with the community, with actors or companies, as well as with the State, in order to obtain resources and political support. The results include providing 80 million people with access to quality water, in addition to the recovery of 200 thousand hectares through forest restoration projects, the promotion of the creation of protected areas and investments in PES. In addition, hydrological and environmental studies are carried out for the implementation of green/natural infrastructure projects. The funds' activities are also based on a logic of encouraging users to charge for water to finance forest, wetland and agricultural conservation measures, necessary to ensure the quantity and quality of water supplied.

Considering the proposal to create financially sustainable funds, in the case of Ecuador, the Quito water company provides its own resources for financing initiatives. The case of Medellín was also presented, in which more than one million dollars was invested, with the return of the proceeds used to finance the project's initiatives. With this, it can be said that the proposed model of the Water Funds functions and provides results and is forecasted to expand to 4 more countries, with the possibility of being replicated in other contexts and being adopted by other cities in countries that are already members of the network.

Amazon Fund

The Amazon Fund is a fund used to attract donations for non-reimbursable investments in projects for: the prevention, monitoring and combating of deforestation, promotion of conservation and sustainable use of the Brazil's Legal Amazon, and development of systems for monitoring and controlling habitat loss in other regions of Brazil and tropical countries. The Fund, created in 2008

through Decree nº 6.527 of August 1st, was responsible for supporting more than 100 projects, with a total financial support of almost R$ 2 billion provided since its inception, according to the Activities Report published in 2018[1]. The resources, from investments and donations, are managed by the National Bank for Economic and Social Development (BNDES), which is responsible for both funding and management of the projects carried out. The NbS initiatives in which the Fund operates concern the conservation of remnants and the restoration of native vegetation, thus fitting into an ecological restoration approach, with 190 protected areas (UCs, in Brazilian Portuguese) supported and 41 million hectares of protected areas with strengthened management through Indigenous lands.

Fundraising follows a logic conditional upon reducing deforestation and consequent reduction of GHG emissions in order to receive new donations and investments. Donations are made both by governments of other countries, such as Germany and Norway, as well as by companies, such as Petrobras. This highlights a poor diversification in the source of funds, according to a trend observed in similar projects.

Green Climate Fund

The Green Climate Fund (GCF) is a funding mechanism created in 2010 from the organization of member countries of the United Nations Framework Convention on Climate Change (UNFCCC). The fund's performance is divided between mitigation and adaptation projects and resources come from both the public and private sectors. The contribution of countries with well-established economies is significant, which made it possible to mobilize more than 10 billion dollars in 2014.

A highlight of the GCF governance model concerns the possibility of direct access by national and subnational organizations to funding, which reduces bureaucracy and the need for intermediation by international agents, thereby facilitating the use of available resources. The available forms of financing are provided through concessions, loans, equity, and guarantees.

Despite this advantage, according to the presentation made at the Forum, the resources made available by the GCF are not being used sufficiently by the water sector. Considering the reciprocal relationship between policies and measures for the management of water resources and actions to mitigate climate change, as well as the different possibilities of adaptation related to the quality

[1] 2018 Amazon Fund Activity Report. Available at: http://www.fundoamazonia.gov.br/export/sites/default/pt/.galleries/documentos/rafa/RAFA_2018_port.pdf

and quantity of surface and groundwater, the need for submission of projects more focused on water was highlighted.

In addition to this description of the GCF and the possibilities of supporting water-related projects, there was also the presentation of a specific case study of the implementation of GCF in Senegal. In this case, the results of the effective implementation of resources from the fund and government resources were presented in the execution of a hydrological risk management and prevention project in the country.

The fund's actions are focused on countries with a high level of vulnerability, especially the least developed countries (LDC), small island developing states (SIDS), and African nations. However, it should be noted that there are applications approved and pending approval for financing actions in South American countries such as Uruguay, Argentina, Colombia, and Ecuador. Although the approaches to nature-based solutions promoted by the fund were not detailed, actions involving ecological restoration (EcR), ecosystem-based mitigation (EbM) and the adoption of green/natural infrastructure (G&NIn) are presented as excellent means of mitigating climate change.

Delta Fund

The Delta Fund, presented in a speech on water management in the Netherlands, consists of a financial mechanism made up of contributions from both the Dutch government and private investments for the implementation of a program to mitigate extreme weather events in the country, especially with regards to flooding.

The Netherlands, due to its geography, is a country that has high availability of water, as well as suffers from high risks of flooding, due to the rise in sea levels as a result of global warming. In order to establish a logic of prevention and mitigation rather than reparation after extreme events, the Delta Program was created in 1995. In 20 years of operation in the country, the program has supported more than 30 projects in five rivers, with resources from the Delta Fund.

This fund receives one billion euros per year through the definition of resources from the central government, agreed upon up until the year 2032. Of the amount derived from the public budget and private sector donations, it was established that more than 55% should be invested in new adaptation measures, with a focus on green/natural infrastructure projects (addressed in a broad sense), whenever possible, and investments in technological innovations. The remaining 45% is allocated to cover the management and maintenance costs of the actions carried out by the program.

Natural infrastructure for water (WRI-Brasil)

In order to guarantee water security and reduce the costs of dredging water bodies and of chemical products used to remove sediment in drinking water treatment processes, the World Resources Institute (WRI-Brazil), in partnership with several institutions, developed projects for the implementation of green/natural infrastructure in reservoirs of the water supply system in 3 river basins in the southeastern region of the country: Cantareira, São Paulo; Jucu, Espírito Santo; and Guandu, Rio de Janeiro. According to the report on the implementation project in Cantareira[2], the restoration of 4,000 hectares was configured as an attractive return on investment (ROI) for water companies and river basin committees. A reduction in costs associated with turbidity control and dredging, by reducing pollution and the consequent curtailment by more than a third of the amount of sediment carried into the system, will account for an estimated ROI of 28% over 30 years. Since these are estimates, with significant uncertainties, it is essential to monitor such processes to prove these results over time.

In addition, several other sources of financing for the implementation of green/natural infrastructure projects are also suggested. The observed trend is towards greater diversification of the portfolio of investors. During the presentation, a green-gray evaluation model was described that analyzes opportunities both from the point of view of what is "artificial", or constructed by human beings, and from the natural aspect of the project, taking the different spheres of ecosystem relations into consideration. The evaluation model consists of the following steps:

1. Definition of the investment;
2. Specification of investment portfolios (carried out in a participatory manner);
3. Modeling of results;
4. Valuation of return on investment (ROI);
5. Comparison between costs and benefits; and
6. Assessment of risks and uncertainties.

Using this roadmap of actions, it is possible to better structure the project and thus enable its full execution. Some of the financing options highlighted were water funds, private equity leverage in the pay-for-success model, and seed capital leverage through corporate donations and government funds. It was found during the study carried out in São Paulo that the programs mostly depend on public resources, which is a limiting factor for their implementation. Some

[2] Natural Infrastructure for Water in the Cantareira System, São Paulo. WRI Brasil. Available at the link: https://wribrasil.org.br/sites/default/files/InfraestruturaNaturalCantareiraSP.pdf.

strategies proposed in the diversification of funding sources stand out: the ecological ICMS (Tax on Circulation of Goods and Services) and the Environmental Compensation Funds (Offset Funds), each with its advantages and limitations. The preparation of a project that is able to obtain varied investors facilitates its full implementation. As with the implementation in watersheds located in the biogeographic region of the Atlantic Forest, additional information is needed to carry out similar assessments in the Caatinga and Pantanal, considering the requirements and challenges to water security in these regions.

Biodiversity conservation and development: nature as part of the solution

In a presentation during the session on socio-environmental justice for water governance, several projects implemented by Boticário Group Foundation were presented. These projects all involve the implementation of NbS, and in some cases PES logic was also applied. Although the detailing of each project was not possible due to the limited time for presentations, the main characteristics of each one will be presented in this section. Firstly, the importance of private sector engagement in conservation was highlighted, including the creation of protected areas and the carrying out of studies on them. The need to promote the implementation and strengthening of public policies aimed at sustainability and the conservation of natural resources is also highlighted.

The investment made in conservation actions corresponded to 1% of the group's net revenue, which represented, for example, the investment of 1 million a year in the Salto Morato Private Natural Heritage Reserve (RPPN). In addition to carrying out studies and research in the RPPN, a network of payments for ecosystem services known as Rede Oásis was established, through which, up to the time of presentation, seven PES projects were implemented with 505 contracted properties and a total of 5,000 hectares of conservation areas. It is worth mentioning the roadmap adopted for Conservation Unit (UC) valuation,[3] which, through an innovative valuation mechanism, takes the environmental quality index and the size of the area, as well as the state of land use into consideration, thus differentiating between the most preserved areas and the most degraded, and allowing the opportunity cost to be identified with greater precision.

Another highlight addressed in the presentation was the importance of multiple sources of funds from both private investments and impact businesses, Water Funds and other sources. In addition, the need to integrate green and

[3] YOUNG, C.E.F. et al. (2015). Roadmap for placing value on the economic and social benefits of protected areas. Electronic book. Available at: https://www.fundacaogrupoboticario.org.br/pt/Biblioteca/Roteiro_valoracao_de_UCs.pdf

gray infrastructures in order to achieve different objectives in different contexts was also highlighted.

Water Producer Program

The Water Producer program, created in 2001 by the National Water and Sanitation Agency (ANA), was addressed in four different presentations during the Forum, one made by a representative of ANA, one by Adasa, one by TNC and another by a rural producer participating in the program, offering differentiated and supplementary perspectives on the program.

The objective of the Water Producer is to promote the improvement of the quality and quantity of water in springs through financial incentives to producers based on PES logic. The program already includes a wide portfolio of projects, with 50 projects in progress, 22 of which were selected in the last public notice, operating in seven metropolitan regions. Since the beginning of the project, R$ 40 million have already been invested by ANA, totaling a contribution of a maximum of 20% of the project's total value. Among the actions carried out under PES logic, the program includes initiatives aimed at raising awareness among the population, both producers and consumers, thereby making it possible to mobilize the community to act as partners in carrying out the project. The results of the program were highlighted, such as the more than 2,000 partner producers and an area of more than 400,000 ha covered, which reflect the successful arrangement, both financially and in terms of governance, with the involvement of various sectors and stakeholders, for the construction of a new model of water resources management.

The financial arrangement for the constitution of the Program funds is quite diverse and involves different sources, including: Federal budget, states and municipalities' budgets, state funds for water resources and the environment, the National Environment Fund, banks and international organizations such as NGOs, GEF and the International Bank for Reconstruction and Development (IBRD), sanitation companies, power generation companies and water users, resources from charging for the use of water, all of that using PES logic and financial compensation on the part of benefited users. This reveals the importance of mobilizing all available sources of investment to make possible the implementation of projects at the watershed level.

The TNC presentation highlighted interest in implementing the program in *Serra da Mantiqueira*, in an area of 1.2 million hectares to be restored with forests of native species covering 240 municipalities. It was indicated that the realiza-

tion of this proposal would reach 10% of the Brazilian target for the Nationally Determined Contribution (iNDC) under the Paris agreement.

In the Adasa presentation, the experience of the Water Producer Project in the Pipiripau river basin, in the Federal District, was highlighted to demonstrate how sustainable rural development is possible, with initiatives (G&NIn + NbS + PES, and others) that minimize impacts on water bodies, favoring the integrated management of these resources in a basin that is prone to water use conflicts. The same session included participation from a rural producer who participates in the Water Producer Program in the same basin, who reported the benefits obtained through the Project, which go far beyond PES.

It is also worth mentioning that the Pipiripau Project[4] was one of the three technical visits in the official program of the 8th World Water Forum.

[4] LIMA, J.E.F.W.; RAMOS, A.E. (2018). The experience of the Water Producer Project in the Ribeirão Pipiripau Hydrographic Basin. Brasília, DF: Adasa, Ana, Emater, WWF-Brazil. 304 p. Available at: http://www.produtordeaguapipiripau.df.gov.br/wp-content/uploads/2018/03/livro.pdf.

5. Conclusions and Recommendations

After defining keywords, the respective coding and frequency analysis of 550 textual documents (summaries and presentations) on the contents discussed in relation to the theme *Water and the Environment* during the 8th World Water Forum, 36 sessions were chosen to be evaluated from a hermeneutic point of view, totaling more than 35 hours of audio and other related documents.

In the set of presentations analyzed, there is a clear message that the evaluation of successful cases and the sharing of experiences allows the exchange of knowledge and the learning process necessary to inspire and formulate strategies that are appropriate to each local context and its specificities.

Whether at the Forum or by other means, there is a need to promote more dissemination and debate on case studies on measures to mitigate and adapt to climate change, nature-based solutions and their financing in the context of water resources management. The history and lessons learned allow for a better understanding of the portfolio of options and innovations and the best solutions for each case. Complex problems related to climate change and NbS for water management cannot normally be solved efficiently and effectively through simple responses.

Engaging a diverse group of stakeholders, including communities and academia, represents a higher transaction cost, but amplify the buy-in and long-term sustainability of climate change mitigation and adaptation, as well as NbS measures. Furthermore, alternatives capable of generating multiple benefits for the different parties minimize the loss-gain relationship and conflicts, thereby facilitating cooperation.

Only the steady promotion of research and development on the relationship between climate change and water management, in addition to the theme of NbS, will be able to generate a series of long-term historical data with the scope and precision necessary to support the innovation development and decision-making processes. This will be facilitated by the systematic use of support

systems and cost-benefit analysis for both infrastructure and public policy implementation.

Risk assessment and the implementation of projects aimed at mitigation and adaptation to climate change and NbS must be carried out and monitored by multidisciplinary groups, including a broad spectrum of professionals, knowledge and skills. Many of these initiatives, due to their high cost, novelty or complexity, need to be segmented into different phases with a long-term perspective.

Another message is that the generation and evaluation of scenarios contemplating different priorities of the parties involved in issues related to the environment and water resources management require the use of both specific methodologies and comparison tools so that it is possible to support the decision-making process in relation to the most appropriate strategies for each context. This will also contribute to scaling up the adoption and impact of nature-based solutions on water supply and the associated opportunities and risks linked to climate change.

Education and training actions, in general, are necessary at all scale levels (global, national and local) aimed at different audiences, exploring different contexts and approaches, as highlighted in most successful cases related to the theme of Water and the Environment reported during the event.

Through means of the long and in-depth analytical process reported in this publication, messages for reflection and recommendations on the three selected key topics (climate change, nature-based solutions, and their financing) were extracted, summarized and indicated below. It is hoped that these findings can contribute to the continuous improvement of the activities of both Adasa in its operations in the Federal District, as well as other agencies and water companies and other actors involved in the management of water resources in other parts of the world.

5.1 Climate Change (CC)

1. Water is one of the most relevant issues under the climate change mitigation and adaptation agenda and involves a reciprocal relationship of risk and opportunity;
2. Since it is impossible to avoid the effects of climate change, it is essential that water agencies and companies consider strategies involving coordination between gray and green/natural infrastructure in their management plans;
3. In this context, communication, coordination, cooperation, and integration of water resources management actions and measures between

the different agents and social actors present in the landscape become even more relevant to promoting solutions for watersheds that are more resilient and adapted to an uncertain future;

4. Focusing efforts only on mitigation or adaptation is not efficient, requiring the implementation of a combination of these strategies that are specific to each context and prioritized in order to generate more sustainable results;
5. Complex vulnerabilities require comprehensive responses that link climate change mitigation and adaptation efforts to the sustainable development of affected communities, thereby increasing their resilience;
6. There is still a significant level of ignorance among the general population about climate change and its possible impacts on daily life, which can be tackled through communication and environmental education campaigns promoted by any sector (civil entities, private companies, governmental and non-governmental organizations);
7. Investment is needed to reduce uncertainty in analyses and projections regarding the relationship between climate change, hydrological regimes, and water management;
8. Stakeholders need to be involved in the decision-making process in relation to uncertainties;
9. The influences and impacts of uncertainties, both financial and technical, must be explicitly considered in processes for technical and political decision-making;
10. Prioritizing preventive actions avoids expenses arising from remediation measures for the impacts generated by extreme weather events (floods, droughts, Indian summers, storm surges, landslides, etc.);
11. Considering questions about the level of uncertainty and confidence, it is essential to constantly assess the quality of readiness to deal with extreme weather events within the scope of the various related instruments (disaster risk analysis, exposure, vulnerability and resilience, contingency planning, reduction, and disaster risk management, etc.); and
12. The investment models adopted for programs and projects aimed at mitigation and adaptation to changes must be developed in a robust manner through means of different strategies, mechanisms and funding sources, in addition to involving different stakeholders, in order to consider the different aspects of uncertainty and complexity related to water security and climate vulnerability.

5.2 Nature-based Solutions (NbS)

1. Nature-based Solutions (NbS) was a recurring topic in the 8th WWF, mainly associated with Integrated Landscape Management (ILM) and Integrated Water Resources Management (IWRM) approaches as a means of facing diverse socio-environmental problems and at the same time generating multiple benefits;
2. NbS can be important tools in guaranteeing water security for present and future generations in light of the limitations of water resources management models that do not fully account for the functions of ecosystems and nature;
3. The experiences presented during the 8th FMA address a wide range of NbS, presented and discussed throughout this report and which can inspire concrete actions by Adasa, as well as other actors involved in the management of water resources;
4. Ecosystem-based mitigation was the strategy most frequently associated with other NbS approaches, proving to be flexible, multi-scale, overarching, and capable of coordinating multiple solutions within a perspective of territorial planning of complex socio-ecological systems;
5. The green/natural infrastructure approach tends to occupy more space in discussions about planning and investing in water storage and distribution systems in large urban areas;
6. Three major trends were observed during the NbS debate: a) encapsulating initiatives to restore degraded ecosystems in broader concepts such as green/natural infrastructure and ecosystem-based mitigation; b) recognizing and providing compensation to rural landowners who produce environmental services through PES mechanisms; and c) the need to bring (through training, experimentation, involvement) civil, sanitation, and water engineers closer to NbS approaches;
7. A practical action is to improve the integration between gray and green/natural infrastructure in order to overcome the intrinsic limitations of each of these approaches;
8. NbS approaches still lack increased and improved data, information, modeling, quantitative cost-benefit analysis, case studies, and long-term monitoring of their effectiveness in order to support the decision-making process in different segments and expand investments;
9. NbS respond to the need for a more holistic and integrated approach to water resources management that considers long-term financing, pro-

motes community engagement, and strengthens territorial governance structures that encourage social participation;

10. NbS approaches must be implemented through structured programs within a sufficient timeframe favoring experimentation and making it possible to: a) evaluate long-term results and impacts; b) generate local data on costs-benefits and generated impacts; c) train employees of the water resources system; d) involve the local population in the implementation of the solutions; and e) cultivate a change in the culture of employees and partners; and
11. Capacity building and training were elements repeatedly presented as being fundamental to any NbS strategy throughout the presentations and debates, such as the inclusion and strengthening of the theme of ecohydrology in academic curricula and in professional environments.

5.3 Financing Nature-based Solutions

1. The theme of Financing Nature-based Solutions was a subject that was rarely addressed at the 8th World Water Forum;
2. Different aspects of funding for the following types of NbS were discussed: Green/Natural Infrastructure and Green/Natural Infrastructure + Gray Infrastructure, Restoration, and Conservation;
3. Among the presentations evaluated, a similar distribution was observed between the types of NbS considered, with a greater number of projects focused on the topic of ecosystem restoration;
4. The most common NbS financing implementation strategies in the Forum materials analyzed were investment funds for socio-environmental impact, followed by development banks, public and private investments, and public-private partnerships;
5. Regarding the financing mechanisms discussed in the sessions (payments for environmental services, tax incentives, and environmental compensation), payment for environmental services was the most presented among the 13 projects analyzed;
6. Organizing efforts to mobilize social and environmental impact investments for the adoption of NbS must include a variety of financial mechanisms: (i) donations, (ii) cash investments, (iii) investments linked to the future purchase of the product, and (iv) blended finance solutions including concessional loans, guarantees, green bonds and grants;
7. Funding the transition to NbS, in which the financial risks associated with these new models are still seen as too great for commercial banks

and/or too expensive for implementers, can be overcome through blended finance initiatives that pool both public and private funds together;

8. The preparation of fundraising strategies for NbS should be specific and include local participation as this facilitates access to international funding ;
9. Robust legal instruments help to ensure long-term funding of NbS initiatives, as well as investments in technological innovations;
10. The number of projects submitted to access Green Climate Fund resources is still below expectations, particularly in the water resources management sector;
11. Expanding the thematic scope of Amazon Fund support in other biogeographic regions of Brazil beyond the monitoring of habitat conversion, and more incisive support for forest restoration through the resumption of specific public notices could leverage the NbS agenda by taking advantage of an already well-established fund; and
12. The dissemination and adoption of solutions inspired by the water funds can benefit from the lessons learned from the models implemented in Brazil, such as: the Reflorestar Project/ES, Water Fund/SP, Water and Forest Producer Guandu/RJ, the Water Producer program in Rio Camboriú/SC, and Water Producer in Ribeirão Pipiripau/DF.

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7. Annexes

Annex 1 – Codes and keywords

Code	Keyword
ADAPTATION & CLIMATE CHANGE*	<(adapt)
	<(climate)
	<(mitiga)
	<(resili)
	<(inunda)
	<(flood)
	"seca"
	"drought"
	"mudanças climáticas"
	"climate change"
	"aquecimento global"
	"global warming"
NATURE-BASED SOLUTIONS*	<(Conserva)
	<(Restaura)
	<(Restora)
	<(nature)
	"floresta?"
	"forest?"
	"serviços ambientais"
	"environment services"
	"infraestrutura verde"
	“green infrastructure”
	"infraestrutura natural"
	“natural infrastructure”
	"Ecosystem-based"
	"baseado em ecossistema*"
	"engenharia ecológica"
	"ecological engineering"
	"Ecosystem-based Management"
	"Climate Adaptation Services"

* Codes referring to the central theme “Water and Environment
** Codes referring to overarching themes related to the central theme
<( ) = considers any suffix added after the stem defined inside the parentheses. Ex. <(adapt), considered to be adaptation, adaptation, adaptive...
? = considers any character in its place. Ex. “forest?”, is considered forestry and forestry practices

Annex 1 – Codes and keywords

Code	Keyword
FINANCING NATURE-BASED SOLUTIONS*	<(financ) (e)
	"gestão de bacias"
	"watershed management"
	<(Conserva)
	<(Restaura)
	<(Restora)
	<(nature)
	"floresta?"
	"forest?"
	"serviços ambientais"
	"environment services"
	"green infrastructure"
	"natural infrastructure"
	"Ecosystem-based"
	"baseado em ecossistema*"
	"engenharia ecológica"
	"ecological engineering"
	"Ecosystem-based Management"
	"Climate Adaptation Services"
EDUCATION & TRAINING**	<(capacita)
	<(ensin)
	<(treina)
	<(train)
	<(educa)
	<(learn)
	"Awareness"
	"Capacity"
SCALE**	<(glob)
	"national"
	"Brasil"
	"Brazil"
	"Distrito Federal"
	"Federal District"
	"location"

* Codes referring to the central theme "Water and Environment
** Codes referring to overarching themes related to the central theme
<( ) = considers any suffix added after the stem defined inside the parentheses. Ex. <(adapt), considered to be adaptation, adaptation, adaptive...
? = considers any character in its place. Ex. "forest?", is considered forestry and forestry practices

Annex 1 – Codes and keywords

Code	Keyword
INNOVATIVE RESEARCH AND TECHNOLOGIES**	<(inovaç?)
	<(innovat?)
	"pesquisa"
	"research"
	<(tecno?)
	<(techn?)
RECOMMENDATIONS**	<(recomend)
	<(recommend)
	"oportunidade"
	"opportunity"
	"tendência?"
	"tendencia?"
	"trend?"

***** Codes referring to the central theme "Water and Environment

****** Codes referring to overarching themes related to the central theme

<( ) = considers any suffix added after the stem defined inside the parentheses. Ex. <(adapt), considered to be adaptation, adaptation, adaptive...

? = considers any character in its place. Ex. "forest?", is considered forestry and forestry practices

Annex 2 – Session analysis worksheet

SESSION DATA	
1	**Session code**
2	**Audio length**
3	**Title**
4	**Theme at 8WWF** *Climate, People, Development, Urban Environment, Ecosystem, Financing, Sharing, Capacity Building, and Governance*
5	**Session summary**
6	**Activities** *Calculation of the proportion of relevant speakers per session*
7	**Session type** *Debate, Round Table, Experience/Case Report, Session Group Summary, Declaration, etc.*
8	**Documents made available and analyzed** *Audio, slideshow presentations, documents, publications and other items*

PRESENTATION DATA	
1	**Audio interval** *Start and end times for speakers' presentations*
2	**Language**
3	**Location** *Identification of the country, region, state or city of origin of the experience*
4	**Name of the initiative/program/project presented**
5	**Presenter's name**
6	**Main institutions involved**
7	**Contextualization of the presentation**

SESSION ANALYSIS		
1	**Objective of the project/program/initiative presented**	
2	**Cost of the project/program/initiative presented**	
3	**Scales** *DF/Local/Regional/National/Global*	
4	**Project Size/Impact** *Amount of carbon, area, number of beneficiaries, etc.*	
5	**Training/education**	*Presence Identified through binary format (Yes or No) and description of the proposal in an open field, if applicable*
6	**Research/Technology/Innovation**	
7	**Trends/recommendations**	

Annex 2 – Session analysis worksheet

8	**Watersheds**	*The presence of information on the topic identified through binary format (Yes or No)*
9	**Payments for Environmental Services**	
10	**Resilience to extreme weather events**	

CLIMATE CHANGE

1	**Mitigation** *Identification of the presence of mitigation initiatives in binary format (Yes or No) and, if applicable the focus of action: Emission reduction and Carbon capture*
2	**Mitigation (sector)** *Agriculture and livestock, Energy, Industry, Waste treatment, Land use, and General use (up to 3 possible options)*
3	**Adaptation** *Identification of the presence of adaptation initiatives in binary format (Yes or No) and, if applicable, the focus of action: Green Infrastructure, Gray Infrastructure, Green and Gray Infrastructures*
4	**Adaptation (sector)** *Agriculture, Water security, Biodiversity, Cities, Disaster risk management, Industry and mining, Infrastructure, Peoples and populations, Health, Coastal zones (up to 3 possible options)*

NATURE-BASED SOLUTIONS

1	**Restoration** *Identification of the presence of restoration iniatives in binary format (Yes or No) with the possibility of a third option Not specified if the topic has been approached on a superficial basis*
2	**Restoration (environment)** *Forests, Savannah, Mangrove, Floodplains, Miscellaneous, Other (specify) (up to 3 options)*
3	**Restoration (purpose)** *Increase infiltration, decrease run-off, Filtering, Mitigation or adaptation, Other (specify) (up to 3 options)*
4	**Size of restoration**
5	**Integrated Landscape Management (ILM)** *Identification of the presence of an ILM component in binary format (Yes or No)*
6	**ILM (action focus)** *Soil conservation, Native vegetation, Water management, Mangrove or coastal area, Watersheds (management), Watersheds (water diversion), Natural disasters, Food production, Industrial production, Other production (fish farming, forestry, etc.), Integration of actions, Others (specify) (up to 3 options)*
7	**ILM (landscape elements)** *Forests (F), Water (W), Soils (S), F+W+S, Land Use, Others (specify);*

Annex 2 – Session analysis worksheet

8	**ILM – organizing the use of landscapes (action focus)** *Population growth OR migration, Mitigation OR climate adaptation, Disaster risk management, Economic Development, Other (please specify)*
9	**Conservation** *Identification of the presence of restoration initiatives in binary format (Yes or No) with the possibility of a third option Not specified if the topic has been approached on a superficial basis*
10	**Conservation (environment)** *Riparian ecosystems and recharge zones, Hilltops and very steep areas, Forests, Savannas, not specified, Other (specify)*
11	**Conservation (objective)** *Biodiversity protection, Climate mitigation or adaptation, Water security, All of the above*
12	**Extent of conservation**

FINANCING NATURE-BASED SOLUTIONS	
1	**Purpose of financing** *Management and conservation of watersheds, Protection of springs and water sources, Conservation of remnants of native vegetation, Restoration of native vegetation, Soil conservation, Mitigation and adaptation to climate change, Implementation of water reuse and treatment systems, Financing for R&D of new technologies, Microfinance of water management services, Gray infrastructure, Other (please specify) (up to 3 options)*
2	**Financing mechanism** *Tax Incentive (TI), Payment for Environmental Services (PES), Environmental Offsets (EO), TI+PES, TI+EO, PES+EO, TI+PES+EO*
3	**Form of implementation** *Bilateral or multilateral cooperation, Development banks, Investment funds for socio-environmental impact, Public investments, Private investments, Blended finance solutions, Public-private partnerships, Performance contracts, River basin committees and similar entitites, Donations/Philanthropy, Environmental offsets, Not specified, Other (please specify)*
4	**Area implemented** *Rural areas, Urban areas, Rural and urban, Indigenous land (IL), Protected Areas (PA), Rural+IL+PA, Others (please specify);*
5	**Governance model adopted**

ADDITIONAL INFORMATION	
1	**Notes**
2	**References** *Electronic sites, publications, and individuals or institutions mentioned during the presentation*
3	**Difficulties encountered during the analysis**

Annex 3 – Presentations on climate change analyzed during the hermeneutics stage.

Code	Project Name	Type	Institutions	Scale	Research and Innovation	Training and Education	Trends and Recommendations	CC Approach
OS-TP-08	How to reduce emissions and costs in the water services sector: the experience of Portugal	CS	National Civil Engineering Laboratory of Portugal (LNEC)	National	YES		YES	ER
OS-TP-08	How to promote sustainable water services: the case of Marseille, France	CS	Marseille Water Society	Subnational/ Local	YES		YES	ER
OS-TP-08	How to promote sustainable water services: the case of Paris, France	CS	Interdepartmental Sanitation Syndicate for the greater Paris metropolitan area	Subnational/ Local	YES			ER
OS-TP-08	How to increase energy efficiency in wastewater treatment: the case of Japan	CS	Japan Sanitation Consortium	National	YES	YES	YES	ER
OS-TP-09	The inclusion of the theme of water in mitigation efforts through the energy sector	C	CAF - Development Bank of Latin America	Global/ Transnational	YES		YES	ER
OS-RP-03	Atoyac River, Puebla case study	CS	Government of Mexico, State Government of Puebla and GIZ	Subnational/ Local	YES	YES	YES	ER GrayIn
OS-TP-42	WINGOC - High quality drinking water from used water	P	WINGOC	Subnational/ Local	YES	YES		ER GrayIn
OS-TP-09	WaCClim	P	GIZ	Subnational/ Local		YES	YES	ER
OS-TP-09	Using education to promote mitigation	P	Water Youth Network	Subnational/ Local		YES		ER G&NIn
OS-TP-08	Water and Wastewater Companies for Climate Mitigation Project (WaCCliM)	P	IWA/GIZ/MMA from Germany	Subnational/ Local			YES	ER

Topic: **CC** = Climate Change; Type: **CS** = Case Study | **P** = Program or Project | **C** = Conceptual; CC Approach: ER = Emission Reduction | **CCS** = Carbon Capture and Storage | **GrayIn** = Gray Infrastructure | **InG = Green Infrastructure** | **GrayIn + InG** = Gray and Green Infrastructurel

Annex 3 – Presentations on climate change analyzed during the hermeneutics stage.

Code	Project Name	Type	Institutions	Scale	Research and Innovation	Training and Education	Trends and Recommendations	CC Approach
OS-TP-08	H2O minus CO2 initiative	P	International Desalination Association	Global/ Transnational			YES	ER
OS-RP-09	Chesf's experience in the Operation of Reservoirs for Power Generation and in Living with the Multiple Uses of Water	CS	São Francisco Hydroelectric Company – Chesf	Subnational/ Local			YES	ER G&NIn
OS-TP-49	Constructed Wetland (off stream) and In-stream Wetland - A successful model for the low cost natural treatment system	CS	National Water Research Center Ministry of Water Resources and Irrigation, Egypt	National	YES			CCS G&NIn
OS-TP-01	1. Women, Water and Work Campaign 2. Project WASH (Water Sanitation and Hygiene)	P	Self-Employed Women's Association (SEWA)	Subnational/ Local	YES	YES	YES	GrayIn
OS-RP-31	Colorado River Case Study: Historic Cooperation During Historic Droughts	CS	Governments of Mexico and USA (federal and state), Water Agencies, NGOs	Global/ Transnational	YES			GrayIn
OS-TP-02	Water Management in the Netherlands: National Experiences and International Ambitions	C	The Dutch government and the country's private sector	National	YES			GrayIn
OS-RP-09	Management of water scarcity in the Durance and Verdon river basin (Provence, France) and sharing experiences with Brazil	CS	International Water Office	National	YES	YES	YES	GrayIn

Topic: **CC** = Climate Change; Type: **CS** = Case Study | **P** = Program or Project | **C** = Conceptual; CC Approach: ER = Emission Reduction | **CCS** = Carbon Capture and Storage | **GrayIn** = Gray Infrastructure | **InG = Green Infrastructure** | **GrayIn + InG** = Gray and Green Infrastructurel

Annex 3 – Presentations on climate change analyzed during the hermeneutics stage.

Code	Project Name	Type	Institutions	Scale	Research and Innovation	Training and Education	Trends and Recommendations	CC Approach
OS-TP-35	Adaptation Fund	P	Colombia Humanitaria, National Unit for Disaster Risk Management (NGRD) and the Adaptation Fund	National	YES		YES	GrayIn
OS-TP-35	Spanish strategies and planning for the development of sustainable and resilient water infrastructure	C	CICCP Water Committee, WCCEP World Council of Engineers, Government of Spain	National	YES	YES		GrayIn
OS-TP-51	Disposal and transport of pollutants from surface to groundwater, Al Faria as a case study	CS	Palestinian Water Authority	Subnational/ Local	YES		YES	GrayIn
SS-J-CF+TP 04	ANA Peru	C	ANA Peru	National	YES			GrayIn
OS-RP-03	Kenya WRM Implementation Support Consultancy	P	RTI International and World Bank	National		YES		GrayIn
OS-RP-47	Principles on Investment and Financing for Water-related Disaster Risk Reduction	C	Ministry of Land, Infrastructure, Transport and Tourism, Japan High-level Experts and Leaders Panel on Water and Disasters (HELP)	National			YES	GrayIn
OS-TP-35	Advances in coastal resilience: mitigation of coastal (land) loss	C	Egypt's National Water Research Center (NWRC)	Global/ Transnational	YES		YES	G&NIn+GrayIn
OS-TP-06	Rés-Alliance (Alliance for Resilience)	P	Network of Basin Organizations of Québec (ROBVQ)	Subnational/ Local		YES	YES	G&NIn+GrayIn

Topic: **CC** = Climate Change; Type: **CS** = Case Study | **P** = Program or Project | **C** = Conceptual; CC Approach: ER = Emission Reduction | **CCS** = Carbon Capture and Storage | **GrayIn** = Gray Infrastructure | **InG = Green Infrastructure** | **GrayIn + InG** = Gray and Green Infrastructurel

Annex 3 – Presentations on climate change analyzed during the hermeneutics stage.

Code	Project Name	Type	Institutions	Scale	Research and Innovation	Training and Education	Trends and Recommendations	CC Approach
SS-J-CF+TP 04	Ecocuencas Action	P	10+ institutions from different countries, for example Colombia, Peru/ Ecuador and Brazil	Subnational/ Local			YES	G&NIn+GrayIn
OS-TP-04	Megacity alliances for water and climate	P	Global Environment Facility	Global				ER
OS-TP-04	Cost-benefit analysis of climate change adaptation measures: Piancó-Piranhas-Açu River Basin	CS	FGV EASP	Local				G&NIn+GrayIn
OS-RP-47	Financing Implementation of Water-related SDGs 8th World Water Forum	P	Financing Implementation of Water-related SDGs 8th World Water Forum (SESSION OPENING)	Global/ Transnational				
OS-TP-02	Flood Management Program (Senegal)	P	Ministry of urban development (Senegal)	National			YES	GrayIn
SS-J-CF+TP 04	Financing funds for the river basin committee and non-governmental organizations	P	Ecocuencas + Rede Brasil (Brazil Network) of basin organisms	National			YES	GrayIn
OS-TP-68	Last Mile Access to Water & Sanitation Finance	P	India Post, Ministry of DW&S, Water.org	National	YES		YES	ER
OS-RP-47	Global leadership for water security and water resources management	P	World Bank	Global/ Transnational			YES	ER
OS-RP-01	Orange Senqu River Comission Water Transfer Project	P	Orasecom	Global/ Transnational				GrayIn

Topic: **CC** = Climate Change; Type: **CS** = Case Study | **P** = Program or Project | **C** = Conceptual; CC Approach: ER = Emission Reduction | **CCS** = Carbon Capture and Storage | **GrayIn** = Gray Infrastructure | **InG = Green Infrastructure** | **GrayIn + InG** = Gray and Green Infrastructurel

Annex 3 – Presentations on climate change analyzed during the hermeneutics stage.

Code	Project Name	Type	Institutions	Scale	Research and Innovation	Training and Education	Trends and Recommendations	CC Approach
OS-TP-35	São Francisco Integration Project – PISF	P	ANA and Codevasf (operator)	Subnational/ Local				GrayIn
OS-TP-58	Public Service Engagement - SIAAP - Greater Paris Sanitation Authority's experience	CS	Interdepartmental Sanitation Syndicate for the greater Paris metropolitan area (or SIAAP, the acronym in French)	Subnational/ Local	YES		YES	ER
OS-TP-42	The San Francisco Water Utility	CS	The San Francisco Water Utility	Subnational/ Local				ER GrayIn
HLP-05	Water for Africa	P	Ministry of Equipment, Transport, Logistics and Water, Kingdom of Morocco	Global/ Transnational				GrayIn

Topic: **CC** = Climate Change; Type: **CS** = Case Study | **P** = Program or Project | **C** = Conceptual; CC Approach: ER = Emission Reduction | **CCS** = Carbon Capture and Storage | **GrayIn** = Gray Infrastructure | **InG = Green Infrastructure** | **GrayIn + InG** = Gray and Green Infrastructurel

Annex 4 – Presentations on nature-based solutions analyzed in the hermeneutics stage.

Code	Project Name	Type	Institutions	Scale	Research and Innovation	Training and Education	Trends and Recommendations	Focus of Action	NbS Approach
OS-RP-30	Environmental Sanitation Program (Phases I and II) Pechincha Hillside Project	P	The Metropolitan Public Company for Potable Water and Sanitation in Quito	Subnational/ Local	YES	YES		ILM	eco-DRR EE G&NIn EbA eco-DRR
OS-RP-30	The limits of urban gray infrastructure: the case of Canal Isabel II in Madrid and the transition to green infrastructure	CS	Canal Isabel II (Madrid sanitation operator)	Subnational/ Local			YES		EbA G&NIn EE
OS-RP-30	Integrating green and gray infrastructure	C	IDB	Global/ Transnational	YES		YES	Conservation	G&NIn
OS-TP-53	Ribeirão Pipiripau Water Producer Project	P	The Regulatory Agency for Water, Energy, and Sanitation of the Federal District - Adasa	Subnational/ Local	YES	YES	YES	ILM restoration Conservation	PES* G&NIn EcR
OS-RP-30	Lago Lacar Project and Water Landscapes Program	P	University of La Plata - Argentina	Subnational/ Local	YES	YES	YES	Restoration Conservation ILM	G&NIn EE EcR
OS-RP-30	The ineffectiveness of the exclusive focus on gray infrastructure: reflections on floods in the Itajaí River, SC	CS	National Center for Risk and Disaster Management	Subnational/ Local			YES		

Topic: **NbS =** Nature-based Solutions; Type: **CS** = Case Study | **P** = Program or Project | **C** = Conceptual; NbS Approach : **EcR** = Ecological Restoration | **EE** = Ecological Engineering | **EbA** = Adaptation Based on Ecosystems | **EbM** = Ecosystem-based Mitigation | **G&NIn** = Green/ Natural Infrastructure | **eco-DRR** = Ecosystem-based Disaster Risk Reduction | **PES*** = Payment for Environmental Services. * - Payment for Environmental Services is not an NbS approach, but an important economic instrument in its implementation. We decided to include it in this table due to the prominence it received in the material evaluated. A more in-depth discussion of PES can be found in section 4.6 Financing Nature-based Solutions

Annex 4 – Presentations on nature-based solutions analyzed in the hermeneutics stage.

Code	Project Name	Type	Institutions	Scale	Research and Innovation	Training and Education	Trends and Recommendations	Focus of Action	NbS Approach
OS-TP-06	Experiences with green and gray infrastructure in the southern United States	CS	US Army Core of Engineers	Subnational/ Local	YES				EbA G&NIn
OS-TP-09 *OS-TP-58* *SS-J-SFG+TP-01*	Bolsa Floresta Program	P	Sustainable Amazon Foundation (FAS) and State Secretariat for the Environment of Amazonas (SEMA-AM)	Subnational/ Local	YES	YES	YES	Restoration Conservation	PES*
OS-TP-04	Water Protection (Evian)	P	DANONE	Subnational/ Local	YES			ILM	EcR EbM
OS-CF-04	Natural water infrastructure (Cantareira and Jucú Systems)	CS	WRI, TNC, Boticário Foundation, IBIO, Natural Capital, IUCN, Femsa Foundation	Subnational/ Local	YES		YES	ILM Restoration	G&NIn EcR
OS-RP-30	The need to expand green infrastructure	C	TNC	Global/ Transnational			YES	Restoration	G&NIn EcR
OS-RP-31	Promoting rainwater harvesting in El Salvador	P	Young Water Fellowship	National		YES			G&NIn
OS-TP-47	IOWater revitalization projects in Africa (and Indonesia)	P	International Office of Water (IOWater)	Global/ Transnational		YES	YES	Restoration ILM	EbM EcR

Topic: **NbS =** Nature-based Solutions; Type: **CS** = Case Study | **P** = Program or Project | **C** = Conceptual; NbS Approach : **EcR** = Ecological Restoration | **EE** = Ecological Engineering | **EbA** = Adaptation Based on Ecosystems | **EbM** = Ecosystem-based Mitigation | **G&NIn** = Green/ Natural Infrastructure | **eco-DRR** = Ecosystem-based Disaster Risk Reduction | **PES*** = Payment for Environmental Services. * - Payment for Environmental Services is not an NbS approach, but an important economic instrument in its implementation. We decided to include it in this table due to the prominence it received in the material evaluated. A more in-depth discussion of PES can be found in section 4.6 Financing Nature-based Solutions

Annex 4 – Presentations on nature-based solutions analyzed in the hermeneutics stage.

Code	Project Name	Type	Institutions	Scale	Research and Innovation	Training and Education	Trends and Recommendations	Focus of Action	NbS Approach
OS-TP-47	Lessons and prospects from pioneering payments for ecosystem services (PES) in Brazil	CS	Grupo Boticário Foundation	Subnational/ Local			YES	Restoration ILM Conservation	G&NIn
OS-TP-47	Bridge between forest and water resources management under natural and anthropogenic changes in watersheds: challenges in Japan	CS	Japan Forestry Agency	National	YES		YES	Restoration ILM Conservation	EbM eco-DRR
OS-TP-51	Pride for Water Engaging and empowering local stakeholders and agencies in Colombia	P	NGO RARE	National	YES	YES	YES		EbA EbM PES*
OS-TP-49	Social Technologies	P	Federal Institute of Paraíba through the Center for Community Consulting on Social Utilities Technologies (Cactus)	Subnational/ Local	YES		YES		EE
SS-CF-01	Case study on the Te Awa Tupua (Whanganui River)	CS	Te Atawhai o Te Ao Research Institute NgāTāngata Tiaki o Whanganui The Government of New Zealand	Subnational/ Local	YES			Conservation	

Topic: **NbS =** Nature-based Solutions; Type: **CS** = Case Study | **P** = Program or Project | **C** = Conceptual; NbS Approach : **EcR** = Ecological Restoration | **EE** = Ecological Engineering | **EbA** = Adaptation Based on Ecosystems | **EbM** = Ecosystem-based Mitigation | **G&NIn** = Green/ Natural Infrastructure | **eco-DRR** = Ecosystem-based Disaster Risk Reduction | **PES*** = Payment for Environmental Services. * - Payment for Environmental Services is not an NbS approach, but an important economic instrument in its implementation. We decided to include it in this table due to the prominence it received in the material evaluated. A more in-depth discussion of PES can be found in section 4.6 Financing Nature-based Solutions

Annex 5 – Presentations on financing nature-based solutions analyzed during the hermeneutics stage.

Code	Project Name	Type	Institutions	Scale	Mechanism	Implementation
OS-TP-09 *OS-TP-58* *SS-J-SFG+TP-01*	Bolsa Floresta Program	P	Sustainable Amazon Foundation (FAS) and State Secretariat for the Environment of Amazonas (SEMA-AM)	Subnational/ Local	PES	PPP
OS-CF-04	Natural water infrastructure (Cantareira and Jucú Systems)	CS	WRI, TNC, Boticário Foundation, IBIO, Natural Capital, IUCN, Femsa Foundation	Subnational/ Local	TI + EC	TI
OS-TP-51	Pride for Water Engaging and empowering local stakeholders and agencies in Colombia	P	NGO RARE	National	PES	
SS-CF-01	Case study on the Te Awa Tupua (Whanganui River)	CS	Te Atawhai o Te Ao Research Institute, NgāTāngata Tiaki o Whanganui and the Government of New Zealand	Subnational/ Local		TI
OS-RP-01	Increasing the use of climate change funds by water projects	P	*Green Climate Fund (GCF)*	Global/ Transnational	EC	TI
SS-J-SFG+TP-01	Biodiversity conservation and development: nature as part of the solution (prospects and challenges)	P	Grupo Boticário Foundation	National	PES	PvI
OS-TP-51	Financing of gray and green infrastructure by the company Quito Water & Sewerage, Ecuador - Fund for the Protection of Water - FONAG	P	French Development Agency (AFD), Fund for the Protection of Water (FONAG)	Subnational/ Local		TI
OS-TP-58	Government Engagement in Payments for Ecosystem Services	CS	Peruvian Ministry of the Environment	National	TI + PES	PbI TI
OS-TP-58	Engagement in Ecosystem Services Fund - Amazon Fund	P	Brazilian National Development Bank (BNDES)	Subnational/ Local	PES	DB

Mechanism: **EO** = Environmental Compensation | **TI** = Tax Incentive | **PES** = Payments for Environmental Services; Implementation: **DB** = Development Banks | **BFS** = *Blended finance solutions* | **CBH**: Watershed and similar committees | **IF** = Investment funds for socio-environmental impact | **PbI** = Public Investments | **PvI** = Private Investments | **PPP** = Public-Private Partnerships

Annex 5 – Presentations on financing nature-based solutions analyzed during the hermeneutics stage.

Code	Project Name	Type	Institutions	Scale	Mechanism	Implementation
OS-TP-58	Water Producer Program	P	ANA – National Water and Sanitation Agency (Brazil)	National	TI+PES	DB PvI+PbI CBH
SS-RP-11	Water Funds (IDB) + TNC	P	*The Nature Conservancy* (TNC), Inter-American Development Bank (IDB) and local governments	Global/ Transnational	PES	PPP BFS
SS-RP-11	Water Fund - Cuencaverde, Medellín	P	*The Nature Conservancy (TNC)*, Inter-American Development Bank (IDB) and local government in Medellín	Subnational/ Local	PES	PPP BFS
SS-J-CF+TP-04	Water Producer	P	*The Nature Conservancy (TNC) and municipalities*	National	TI+PES	DB PvI+PbI CBH

Mechanism: **EO** = Environmental Compensation | **TI** = Tax Incentive | **PES** = Payments for Environmental Services; Implementation: **DB** = Development Banks | **BFS** = *Blended finance solutions* | **CBH**: Watershed and similar committees | **IF** = Investment funds for socio-environmental impact | **PbI** = Public Investments | **PvI** = Private Investments | **PPP** = Public-Private Partnerships

Annex 6 – Sessions and lectures considered in the analysis of the Water and Environment theme

The complete analytical matrix of these sessions is available at the following link: <https://www.adasa.df.gov.br/publicacoes-da-adasa>

LOCAL SCALE

SESSION	PRESENTATION SUBJECT	SPEAKER	INSTITUTION
OS-TP-47	Lessons and perspectives from a pioneer Payment for Ecosystem Services (PES) initiative in Brazil: OÁSIS	Thiago Piazzetta	*Fundação Grupo Boticário*
SS-RP-11	Case: Water Fund - Medellín, Colombia	Maria Claudia de la Osa	Inter-American Development Bank (BID) and The Nature Conservancy (TNC)
SS-J-SFG+TP-01 OS-TP-09 OS-TP-58	Innovative approach of payments for ecosystem services in the Amazon Rainforest: Bolsa Floresta Programme.	Nayandra Pereira e Victor Salviatti	*Fundação Amazônia Sustentável (FAS) and Secretaria de Estado do Meio Ambiente do Amazonas (SEMA-AM)*
OS-RP-30	Ecosystems protection and green infrastructure for flood control and water security in Quito, Ecuador	Xavier Vidal	*Empresa Pública Metropolitana de Agua y Saneamiento de Quito (EPMAPS)*
OS-TP-01	1. Women, Water and Work Campaign 2. Project WASH (Water Sanitation and Hygiene)	Bharti Bavsar	Self-Employed Women's Association (SEWA)
OS-TP-06	*Rés-Alliance (Alliance for Resilience)*	Marc André Demers	Network of Basin Organizations of Québec (ROBVQ)
OS-CF-04	Natural Infrastructure ROI Analysis: Sao Paulo Water fund	Rafael Barbieri	World Resources Institute (WRI)
OS-TP-51	Pollutants Fate and Transport from Surface to Groundwater, Al Faria as a Case Study	Malak Issa	Palestinian Water Authority
SS-J-CF+TP 04	Acción Eco Cuencas	Eduardo Cuoco Léo	Parternship among institutions from several countries
OS-RP-09	CHESF's Experience in the Operation of Reservoirs for Power Generation and in Managing Multiple Uses of Water	João Henrique de Araújo Franklin Neto	*Companhia Hidroelétrica do São Francisco – CHESF*
OS-TP-08 OS-TP-09	1. Improving Utility Performance while Adopting a Low-Carbon Mindset 2. Water utilities moving towards carbon neutrality: Planning locally, impacting globally	Corinne Trommsdorf and Astrid Michels	International Water Association (IWA) and German Agency for International Cooperation (GIZ)
OS-TP-51	Financing Grey & Green Infrastructures of the Quito Water & Sewerage company, Ecuador	François Sueur	French Development Agency (AFD) and *Fundo de Proteção da Água (FONAG)*
OS-RP-30	Mainstreaming natural infrastructure into planning: Experiences from Argentina	Marcelo Gaviño Novillo	*Universidad de la Plata - Argentina*

ENGLISH

LOCAL SCALE

SESSION	PRESENTATION SUBJECT	SPEAKER	INSTITUTION
OS-TP-49	Social Technologies?	Artur Moises Gonçalves Lourenço	*Instituto Federal da Paraíba (IFPB) / Centro de Assessoria Comunitária a Tecnologias de Utilidades Sociais (Cactus)*
OS-TP-35	PISF – São Francisco river Integration Project	Oscar de Moraes Cordeiro Netto	*Agência Nacional de Águas (ANA)*
OS-TP-09	Using education to promote mitigation	Leah Pope	Water Youth Network
OS-RP-03	CLIMATE CHANGE, Challenges and Opportunities - The case of the Atoyac River, Puebla	José Luis Romero Morales	Government of Mexico and GIZ
OS-RP-30	Green infrastructures and urban resilience in the planning of the integral water cycle	Antonio Lastra	*Canal de Isabel II,* Madrid, Spain
OS-TP-04	Comparative multiple case study of international experiences with water markets	Layla Lambiasi	*Escola de Administração de Empresas de São Paulo (EAESP-FGV)*
OS-TP-58	Funding for the safeguarding of ecosystems at the local scale - Greater Paris Sanitation Authority's experience	Tristan Milot	Greater Paris Sanitation Authority (SIAAP)
OS-TP-06	USACE Approach to Integrating Climate Science and Water Management	Will Veatch	US Army Corps of Engineers
OS-TP-08	A zero carbon water supply service: the case of the territory of the Great Marseille (France)	Catherine Lagarde	*Société des Eaux de Marseille*
OS-TP-04	How climate change affects all the different water users: The need for cross-sectoral approaches for adaptation	Eric Soubeiran	*Evian/Danone*
OS-TP-42	50 Years of Direct Potable Reuse in Windhoek	Thomas Honer	*Wingoc - Windhoek Goreangab* Operating Company - Namibia
OS-TP-58	Challenges in financing forestry conservation and water production	Eduardo Bizzo	*Banco Nacional de Desenvolvimento (BNDES)*
SS-CF-01	Recognising our River's Rights – A case study of Te Awa Tupua (Whanganui River)	Rāviri Tinirau	*Te Atawhai o Te Ao* Research Institute, *NgāTāngata Tiaki o Whanganui* and Government of New Zealand

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NATIONAL SCALE

SESSION	PRESENTATION SUBJECT	SPEAKER	INSTITUTION
OS-RP-09	Water and energy during crises: Brazilian and French experiences Management of water scarcity in the Durance and Verdon river basins (Provence, France) and shared experiences with Brazil	Nicolas Bourlon	International Office for Water (IOWater), France
OS-TP-51	Engaging and empowering stakeholders and local agencies in Colombia	Catalina Mejia	RARE (ONG)
OS-TP-58	Water Producer Program	Devanir Garcia dos Santos	*Agência Nacional de Água (ANA)*
OS-TP-35	Spanish strategies and planning for sustainable and resilient water infrastructure developement	Tomas Sancho	CICCP Water, Energy and Environment Committee / World Council of Civil Engineers (WCCE) / Goverment of Espanha
OS-TP-02	Flood Management Program (Senegal) Spanish strategy of initiatives in response to hydroclimatic risks (Spain) Hydroclimatic security in the Lazio region (Italy)	Olivier Crespi (France)	*Ministère de l'Urbanisme* (Senegal), CICCP Water, Energy and Environment Committee, and IDB (USA)
OS-TP-68	Sharing technological, social and financial innovations	Claire Lyons	Water.org and India Post Ministry of DW&S
OS-TP-47	Bridging between forest and water resources management under natural and anthropogenic changes of watersheds: Challenges in Japan	Takashi Gomi	Forestry Agency - Japan
SS-J-SFG+TP-01	Biodiversity conservation and development: nature as part of the solution	Thiago Valente	*Fundação Grupo Boticário*
OS-RP-03	Supporting WRM in Kenya	Gene Brantly	RTI International and Workd Bank
SS-J-CF+TP 04	ANA Peru	Pedro Guerreiro	*Autoridad Nacional del Agua (ANA) - Peru*
OS-TP-08	Wastewater Treatment Technology for Zero-carbon Society Sludge Recycling in Japan	Takehiko Kawai	Japan Sanitation Consortium
OS-TP-35	Fondo Adaptación	Iván Mustafá Durán,	*Colômbia Humanitária,* National Unit for Disaster Risk Management (UNGRD) and Adaptation Fund
OS-RP-31	Case study Central America: harvesting rainwater and involving women in alternative solutions to face droughts	Vilma Chanta Young	Water Fellowship
OS-TP-58	Financing for ecosystem services: governmental perspective.	José Luiz Ruiz	*Ministerio del Ambiente - Perú*

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NATIONAL SCALE

SESSION	PRESENTATION SUBJECT	SPEAKER	INSTITUTION
OS-TP-53	Farming for ecosystem services: can farmers save rivers and still make a profit?	Jorge Werneck Lima	*Embrapa / ADASA*
OS-TP-49	Engineered Wetland (off stream) and In-stream Wetland - A Successful Model for Natural Low Cost Treatment System - Egypt case	Ashraf El Sayed	Drainage Research Institute (DRI), National Water Research Centre (NWC) and Ministry of Water Resoures and Irrigation, Egypt
OS-TP-02	"Water Management in the Netherlands: National Experiences and International Ambitions"	Koos Wieriks	Government of The Netherlands and the country's private sector
OS-RP-47	"Principles on Investment and Financing for Water-related Disaster Risk Reduction"	Tomoyuki Okada	Ministry of Land, Infrastructure, Transport and Turism - Japan
SS-J-CF+TP 04	Funds for financing river basin committees and non-governmental organizations	Rafaela Barash	*Ecocuencas + Rede Brasil de Organismos de Bacia*

GLOBAL SCALE

SESSION	PRESENTATION SUBJECT	SPEAKER	INSTITUTION
SS-RP-11	Water Funds, financial mechanisms for watershed conservation through nature-based solutions	Agustín Aguerre	Inter-American Development Bank (BID) and The Nature Conservancy (TNC)
OS-TP-47	1. Congo basin Water Information System including Spatial technologies 2. Indonesia – Coastal erosion and floods in Northern Java	Alain Bernard	International Office for Water (IOWater), France
OS-RP-30	Setting the Global Context for Green Infrastructure Investment	Andrea Erickson-Quiroz	The Nature Conservancy (TNC)
OS-RP-01	Water Security and Climate Resilience for Sustainable Development	Alastair Morrison	Green Climate Fund (GCF)
OS-TP-09	The inclusion of the water issue in mitigation efforts through the energy sector	Franz Rojas	Development Bank of Latin America (CAF)
HLP-05	High Level Panel on Water and Climate - Bridging Water and Climate	Charafat Afilail	Government of Morocco
OS-RP-30	The IDB and Green Infrastructure in Latin America and the Caribbean	Raúl Muñoz Castillo	Inter-American Development Bank (BID)
OS-RP-01	Mexico & the United States - Colorado River Case Study: Historic Cooperation During Historic Drought	Robert Snow, US Department of the Interior	Governments of Mexico and the USA (national and sub-national), Water Agencies, NGOs
OS-RP-47	Financing Implementation of Water-related SDGs	Curt Garrigan	The Economic and Social Commission for Asia and the Pacific (ESCAP)
OS-RP-01	Water Security and Climate Resilience for Africa's Sustainable Development – Climate Investment Planning at River Basin Level: Experiences from the Orange Senqu River Commission	Lenka Thamae	Orange-Senqu River Basin Commission (ORASECOM) and Asian Development Bank (ADB)
OS-TP-08	*Global Clean Water Alliance – H2O minus CO2 initiative*	Miguel Sanz	International Desalination Association
OS-TP-01	You cannot manage what you cannot measure	Johannes Collman	World Meteorological Organization (WMO)
OS-TP-35	Advancements in Coastal Resilience - Mitigation of Coastal Land Loss	Ahmed Gaweesh	National Water Research Center (NWRC), Egypt
OS-TP-04	Impact of Climate Change on Water Users and the Need for Cross-Sector Collaboration	Astrid Hillers	Global Environment Facility (GEF)
OS-RP-47	Global leadership for water security and water resources management	Greg Browder	World Bank

ENGLISH