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Central America and the Dominican Republic

Regional Assessment

Status of Disaster Risk Management in the Water Supply and Sanitation Sector – Policy Framework and Practice

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Acknowledgements

This report summarizes the results of the Economic and Sector Work (ESW) on the “Status of Disaster Risk Management (DRM) in the Water Supply and Sanitation (WSS) Sector – Policy Framework and Practice in Central America and the Dominican Republic.” It responds to a request from the Central American and Dominican Republic Forum for Drinking Water and Sanitation (FOCARD-APS) and would have not been possible without the coordination and analytical inputs of its Regional Thematic Group for Disaster Risk Management (RTG-DRM). It is the result of a concerted effort conducted with financial and technical assistance from the World Bank, the Swiss Agency for Development and Cooperation (SDC) through its Water and Sanitation Program (AGUASAN) in Central America, and contributions from international and local partners.

The RTG-DRM facilitated field visits, data gathering, preparation, and validation of country and regional assessments, and played a critical role in galvanizing consultation and policy dialogue with experts from regional bodies, national institutions, and stakeholders involved in both areas—disaster risk management and climate change adaptation and the water and sanitation sector—in Central America and the Dominican Republic. This effort, framed within the RTG-DRM Action Plan, was coordinated by Luis Carlos Vargas, AyA Costa Rica, with the support of Nancy Pagoada, SANAA Honduras; Ernesto Castellanos, ANDA El Salvador; Carlos Barrios, MSPAS Guatemala; Francisco Reyes, ENACAL; Elda Cruz, MINSA Panama; Tomasa Cañete, IDAAN Panama; and Elvira Segura and Francisca Leyva, INAPA Dominican Republic.

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Disclaimer

The findings, interpretations, and conclusions expressed in this paper are the result of analysis and sector dialogue and do not necessarily reflect the views of the executive directors of the World Bank, the sponsors, or the governments that the participating institutions represent. The World Bank does not guarantee the accuracy of the data included in this work. The boundaries, colors, denominations, and other information shown on any map in this work do not imply any judgment on the part of the World Bank concerning the legal status of any territory or the endorsement or acceptance of such boundaries.

Limitations

The methodology applied for carrying out this analytical work is not intended to establish an assessment model. Rather, it provides a snapshot of the progress made by the FOCARD-APS member countries, aimed at fostering policy dialogue and helping them plan and carry out actions to incorporate disaster risk management and climate change adaptation in WSS policy frameworks and practices in Central America and the Dominican Republic. The guidelines for interviewing WSS institutions combined the analytical framework proposed by Ghesquiere and Mahul (2010) in “Sendai Report: Managing Disaster Risks for a Resilient Future” (2012) and the “Guide to Assess Risk Management and Climate Change Adaptation in Sectors” (World Bank 2012), which was adapted to the WSS sector and validated by the RTG-DRM. Parameters were evaluated qualitatively. The report is based on thorough document review, country visits for data collection, and consultation with experts from national institutions and regional bodies. The assessment was validated through national and regional workshops by national institutions and FOCARD-APS.

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List of Abbreviations

ANA	National Water Authority - Nicaragua
AECID	Spanish Agency for International Development Cooperation
AMUNIC	Nicaragua Association of Municipalities
ANDA	National Water and Sewerage Administration – El Salvador
ARESEP	National Public Services Authority – Panama
ASADAS	Administrative Associations of Rural Water and Sanitation Systems – Costa Rica
ASEP	Public Services Regulatory Agency
ASOCAR	Rural Water Supply Community Associations
AyA	Costa Rican Institute of Aqueducts and Sewers
BNCR	National Bank of Costa Rica
CABEI	Central American Bank for Economic Integration
CAPRA	Probabilistic Risk Assessment Program
Cat DDO	Catastrophe Deferred Drawdown Option
CCA	Climate Change Adaptation
CCAD	Central American Commission for Environment and Development
CCRIF	Central America and Caribbean Catastrophe Risk Insurance Facility
CEPREDENAC	Center for Coordination of Prevention of Natural Disasters – Central America
CFIA	Costa Rican Federated Confraternity of Engineers
CONASA	National Council on Drinking Water Supply and Sanitation – Honduras
CONVERGIRH	Central American Covenant for Water Resource Management
CONRED	National Coordination for Disaster Reduction – Guatemala
COPECO	Permanent Contingency Commission of Honduras
COSUDE	Swiss Agency for Cooperation and Development
CPS/CPF	Country Partnership Strategy / Framework
CRRH	Regional Committee on Water Resources in Central America
DANA	Damage Assessment and Needs Analysis
DPL	Development Policy Loan
DRM	Disaster Risk Management
ECAGIRH	Central American Integrated Water Resources Management Strategy
ECHO-EU	European Commission – Humanitarian Aid and Civil Protection
ECLAC	Economic Commission for Latin America and the Caribbean
EMPAGUA	Municipal Water Company of Guatemala City
ENACAL	Nicaraguan Water and Sewerage Company
ERCC	Regional Strategy for Climate Change
ERSAPS	Honduran Drinking Water and Sanitation Service Regulator
ESW	Economic and Sector Work
FCAS	Spanish Cooperation Fund for Water and Sanitation
FISE	Nicaraguan Social Investment Fund
FOCARD-APS	Central American and Dominican Republic Forum for Potable Water and Sanitation
FOCEGIR	Fund for Promotion of Integrated Climate Risk Management in Central America
GDP	Gross Domestic Product
GEF	Global Environmental Facility
GIZ	German Society for International Cooperation
IBRD	International bank for Reconstruction and Development
ICR	Implementation Completion Report
IDA	International Development Association
IDAAN	Panama National Institute of Aqueducts and Sewers
IDB	Inter-American Development Bank
INAPA	National Institute of Drinking Water and Sewerage of Dominican Republic
IPCC	Intergovernmental Panel on Climate Change
IRM	Immediate Response Mechanism
IUWM	Integrated Urban Water Management
IWRM	Integrated Water Resource Management
JICA	Japan International Cooperation Agency
JMP	Joint Monitoring Programme
KfW	German Development Bank
LAC	Latin America and the Caribbean
MAPAS	Monitoring Country Progress in Water Supply and Sanitation
MDG	Millennium Development Goals
MEGIRC	Framework for Integrated Climate Risk Management
MIDEPLAN	Ministry of National Planning and Economic Policy of Costa Rica
MINSA	Panamanian Ministry of Health
MSPAS	Guatemalan Ministry of Public Health and Social Assistance

PACAGIRH	Central American Integrated Water Resources Management Plan
PAHO	Pan American Health Organization
PARCA	Environmental Plan of the Central America Region
PCGIR	Central America Policy for Comprehensive Disaster Risk Management
PDO	Program Development Objective
PES	Payment for Ecosystem Services
PIEVC	Public Infrastructure Engineering Vulnerability Committee
PNRRD	National Platform for Disaster Risk Reduction
PREVDA	Regional Program for the Reduction of Vulnerability and Environmental Degradation
RASHON	Honduran Water and Sanitation Network
RASNIC	Nicaraguan Water and Sanitation Network
SANAA	National Autonomous Water and Sewerage Service - Honduras
SCD	Systematic Country Diagnostic
SDC	Swiss Agency for Development and Cooperation
SDG	Sustainable Development Goals
SELA	Latin American and the Caribbean Economic System
SERNA	Secretary of Natural Resources and Environment - Honduras
SIASAR	Rural Water and Sanitation Information System
SICA	Central American Integration System
SINAGER	National Risk Management System - Honduras
SINAPRED	National System for Disasters Prevention, Mitigation and Response - Nicaragua
SINAPROC	National Civil Protection System – Panama
SNET	National Service of Territorial Studies – El Salvador
SNGR	National Risk Management System
SNIP	National Public Investment Planning System
UNICEF	United Nations Children's Fund
UNISDR	United Nations International Strategy for Disaster Reduction
WASH	Water Supply, Sanitation, and Hygiene
WHO	World Health Organization
WRM	Water Resources Management
WSP	Water and Sanitation Program
WSS	Water Supply and Sanitation

Glossary of Key Terms

All terms adopted from the Intergovernmental Panel on Climate Change, unless otherwise noted.[1]

Adaptation
In human systems, the process of adjustment to actual or expected climate and its effects, in order to moderate harm or exploit beneficial opportunities. In natural systems, the process of adjustment to actual climate and its effects; human intervention may facilitate adjustment to expected climate.

Climate change
A change in the state of the climate that can be identified (e.g., by using statistical tests) by changes in the mean and/or the variability of its properties and that persists for an extended period, typically decades or longer. Climate change may be due to natural internal processes or external forcings, or to persistent anthropogenic changes in the composition of the atmosphere or in land use.

Climate extreme (extreme weather or climate event)
The occurrence of a value of a weather or climate variable above (or below) a threshold value near the upper (or lower) ends of the range of observed values of the variable. An extreme weather event is an event that is above (or below) the 90th or 10th percentile of its statistical reference distribution at a particular place. By definition, the characteristics of extreme weather may vary from place to place. An extreme climate event is an average of a number of weather events over a certain period of time, an average which is itself extreme (e.g. rainfall over a season). For simplicity, both extreme weather events and extreme climate events are referred to collectively as 'climate extremes.'

Damage
Total or partial destruction of physical assets existing in the affected area. Damage occurs during and after the disaster and is measured in physical units (i.e. meters of pipes, etc.). Its monetary value is expressed in terms of replacement costs according to prices prevailing just before the event. (GFDRR, 2010[2])

Disaster
Severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse

[1] *IPCC Managing the Risks of Extreme Events and Disasters to Advance Climate Change Adaptation*, https://www.ipcc.ch/pdf/special-reports/srex/SREX-Annex_Glossary.pdf ; and *IPCC Fourth Assessment Report: Climate Change* http://www.ipcc.ch/publications_and_data/ar4/wg2/en/annexessannex-i.html.
[2] World Bank Global Facility for Disaster Reduction and Recovery, 2010, *Damage, Loss and Needs Assessment Guidance Notes*, *Volume 2: Conducting Damage and Loss Assessments after Disasters*, http://gfdrr.org/sites/gfdrr.org/files/publication/Damage%20Volume2-WEB.pdf.

human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery.

Disaster risk

The likelihood over a specified time period of severe alterations in the normal functioning of a community or a society due to hazardous physical events interacting with vulnerable social conditions, leading to widespread adverse human, material, economic, or environmental effects that require immediate emergency response to satisfy critical human needs and that may require external support for recovery.

Disaster risk management

Processes for designing, implementing, and evaluating strategies, policies, and measures to improve the understanding of disaster risk, foster risk reduction and transfer, and promote continuous improvement in disaster preparedness, response, and recovery practices, with the explicit purpose of increasing human security, well-being, quality of life, and sustainable development.

Drought

The phenomenon that exists when precipitation is significantly below normal recorded levels, causing serious hydrological imbalances that often adversely affect land resources and production systems. For example, shortage of precipitation during the growing season impinges on crop production or ecosystem function in general (due to soil moisture drought, also termed agricultural drought), and during the runoff and percolation season primarily affects water supplies (hydrological drought). A period with an abnormal precipitation deficit is defined as a meteorological drought. A severe drought last over six dry months with low rainfall (800-1,200 mm / year) and high potential evapotranspiration (averaging more than 200 mm/month). A high drought last between 4 and 6 dry months with mean rainfall (1,200-1,600 mm/year) and mean evapotranspiration (averaging roughly 130 mm/month). A low drought last between 4 and 6 dry months with high rainfall (1,600-2,000 mm / year) and low evapotranspiration (averaging less than 100 mm/month). A prolonged drought last longer than normal. A megadrought is a very lengthy and pervasive drought, lasting a decade or more.

Early warning system

The set of capacities needed to generate and disseminate timely and meaningful warning information to enable individuals, communities, and organizations threatened by a hazard to prepare and to act appropriately and in sufficient time to reduce the possibility of harm or loss.

El Niño - Southern Oscillation (ENSO)

The term El Niño was initially used to describe a warm-water current that periodically flows along the coast of Ecuador and Peru, disrupting the local fishery. It has since become identified with a basin-wide warming of the tropical Pacific Ocean east of the dateline. This oceanic event is associated with a fluctuation of a global-scale tropical and subtropical surface pressure pattern called the Southern Oscillation. This coupled atmosphere-ocean phenomenon, with preferred time scales of 2 to about 7 years, is collectively known as the El Niño-Southern Oscillation. It is often measured by the surface pressure anomaly difference between Darwin and Tahiti and the sea surface temperatures in the central and eastern equatorial Pacific. During an ENSO event, the prevailing trade winds weaken, reducing upwelling and altering

ocean currents such that the sea surface temperatures warm, further weakening the trade winds. This event has a great impact on the wind, sea surface temperature, and precipitation patterns in the tropical Pacific. It has climatic effects throughout the Pacific region and in many other parts of the world, through global teleconnections. The cold phase of ENSO is called **La Niña**.

Emission Scenarios
A plausible representation of the future development of emissions of substances that are potentially radiatively active (e.g., greenhouse gases, aerosols), based on a coherent and internally consistent set of assumptions about driving forces (such as technological change, demographic and socioeconomic development) and their key relationships. Concentration scenarios, derived from emissions scenarios, are used as input to a climate model to compute climate projections. In the IPCC 1992 Supplementary Report, a set of emissions scenarios was presented, which were used as a basis for the climate projections in the IPCC Second Assessment Report. These emissions scenarios are referred to as the IS92 scenarios. In the IPCC Special Report on Emissions Scenarios, new emissions scenarios, the so-called SRES scenarios, were published.

Exposure
People, property, systems, or other elements present in hazard zones that are thereby subject to potential losses.

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

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

Hydrological cycle (also referred to as water cycle)
The cycle in which water evaporates from the oceans and the land surface, is carried over the Earth in atmospheric circulation as water vapor, condenses to form clouds, precipitates again as rain or snow, is intercepted by trees and vegetation, provides runoff on the land surface, infiltrates into soils, recharges groundwater, and/or discharges into streams and flows out into the oceans, and ultimately evaporates again from the oceans or land surface.

Integrated Water Resources Management (IWRM)
A process which promotes the coordinated development and management of water, land and related resources in order to maximize economic and social welfare in an equitable manner without compromising the sustainability of ecosystems. (UN-Water, 2015[3])

[3] UN-Water, Water Resources Management, http://www.unwater.org/topics/water-resources-management/en/

La Niña
See El Niño-Southern Oscillation (ENSO).

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

Mitigation (of disaster risk and disaster)
The lessening of the potential adverse impacts of physical hazards (including those that are human induced) through actions that reduce hazard, exposure, and vulnerability.

Preparedness
The knowledge and capacities developed by governments, professional response and recovery organizations, communities and individuals to effectively anticipate, respond to, and recover from, the impacts of likely, imminent or current hazard events or conditions. (UNISDR, 2015[4])

Resilience
The ability of a social or ecological system to absorb disturbances while retaining the same basic structure and ways of functioning, the capacity for self-organization, and the capacity to adapt to stress and change.

Risk retention
The process whereby a party retains the financial responsibility for loss in the event of a disaster. (World Bank, 2009[5])

Risk transfer
The process of formally or informally shifting the financial consequences of particular risks from one party to another whereby a household, community, enterprise, or state authority will obtain resources from the other party after a disaster occurs, in exchange for ongoing or compensatory social or financial benefits provided to that other party.

Risk assessment
A methodology to determine the nature and extent of risk by analyzing potential hazards and evaluating existing conditions of vulnerability that together could potentially harm exposed people, property, services, livelihoods and the environment on which they depend. (UNISDR, 2015)

Tropical cyclone
The general term for a strong, cyclonic-scale disturbance that originates over tropical oceans. Distinguished from weaker systems (often named tropical disturbances or depressions) by exceeding a threshold wind speed. A tropical storm is a tropical cyclone with one-minute

[4] The United Nations Office for Disaster Risk Reduction (UNISDR), *Terminology*, http://www.unisdr.org/we/inform/terminology
[5] World Bank, *Catastrophic Risk Financing in Developing Countries*, http://siteresources.worldbank.org/FINANCIALSECTOR/Resources/CATRISKbook.pdf

average surface winds between 18 and 32 m s-1. Beyond 32 m s-1, a tropical cyclone is called a hurricane, typhoon, or cyclone, depending on geographic location.

Vulnerability
The characteristic of a community, system, or asset that makes it susceptible to damaging effects of hazards. (UNISDR, 2015)

Water scarcity
An imbalance between supply and demand of freshwater in a specified domain (country, region, catchment, river basin, etc.) as a result of a high rate of demand compared with available supply, under prevailing institutional arrangements (including price) and infrastructural conditions. Its symptoms are: unsatisfied demand, tensions between users, competition for water, over-extraction of groundwater and insufficient flows to the natural environment. Artificial or constructed water scarcity refers to the situation resulting from over-development of hydraulic infrastructure relative to available supply, leading to a situation of increasing water shortage. Chronic water scarcity refers to a level beyond which water supply can only be made available through the use of non-conventional water resources such as agricultural drainage water, treated wastewater or desalinated water, or by managing demand. A range between 500 and 1000 cubic meters/person/year has often been used as a proxy to indicate chronic water scarcity. (FAO, 2015[6])

Water shortage
A shortage of water supply of an acceptable quality; low levels of water supply, at a given place and a given time, relative to design supply levels. The shortage may arise from climatic factors, or other causes of insufficient water resources, a lack of, or poorly maintained, infrastructure; or a range of other hydrological or hydro-geological factors. (FAO, 2015)

Water security
The capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being, and socio-economic development, for ensuring protection against water-borne pollution and water-related disasters, and for preserving ecosystems in a climate of peace and political stability. (FAO, 2015)

Water stress
An area is experiencing water stress when annual water supplies drop below 1,700 m3 per person. (UNESCO-Water, 2012[7])

[6] UN Food and Agriculture Organization, AQUASTAT, Glossary, http://www.fao.org/nr/water/aquastat/data/glossary/search.html
[7] UN Water Development Report, Managing Water under Uncertainty and Risk, http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/WWDR4 Volume 1 Managing Water under Uncertainty and Risk.pdf

Executive Summary

The purpose of this economic and sector work (ESW) is to support the FOCARD-APS member countries[8] in improving the resilience of their water supply and sanitation (WSS) services. This report summarizes the findings from seven country-specific assessments carried out in 2013 and 2014 that characterize the national disaster risk management (DRM) and climate change adaptation (CCA) frameworks and efforts designed to reduce the vulnerability of WSS services to disasters and climate change. This activity also supports the World Bank strategy for enhancing DRM in Central America.[9]

This analytical effort is the result of a comprehensive participatory process that contributed to building the analytical capacities of the institutions that conform the FOCARD-APS's Regional Thematic Group for Disaster Risk Management (RTG-DRM). It involved thorough document reviews and two rounds of country visits for data collection, as well as consultation with national and regional experts. The findings of all assessments were validated through national and regional workshops by the RTG-DRM. Regional learning exchanges and study visits were organized as part of this activity to provide policy makers with concrete examples of approaches and potential measures for addressing disaster risk challenges from a WSS service provision perspective and through a broader political and sectoral scope covering policy development, financing, capacity building, and institutional reform.[10]

Background and Challenges

Central America and the Dominican Republic represent seven diverse countries that face a shared set of challenges. Some 44 percent of the subregion's 55 million residents live below the poverty line. Reliable water and sanitation services contribute to poverty reduction, though long-standing issues of coverage and quality remain, as 5.5 million people lack access to improved drinking water and 12.7 million to improved sanitation. Increasingly scarce water resources—driven by uneven spatial and seasonal distribution of precipitation, rapid population growth and urbanization, competition with agriculture and industry, and deficient infrastructure—complicate efforts to broaden coverage. Meanwhile, the subregion is highly exposed to natural hazards, from hurricanes and floods to earthquakes and volcanoes, that threaten to undermine sector progress. Frequent natural disasters exact a toll on WSS infrastructure that hampers service, affecting the lives and livelihoods of residents. The WSS sector can take concrete actions to improve resilience to climate variation and natural hazards, as outlined below.

[8] FOCARD-APS member countries include Costa Rica, Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, and Panama.

[9] World Bank (2012). Programmatic Knowledge Services: "Enhancing Disaster Risk Management in Central America" (P145227)

[10] For example, technical assistance was provided through the CAPRA program (P144982) to the national WSS utilities of Honduras, SANAA, and Panama (IDAAN) for strengthening WSS utilities' institutional capacity to implement probabilistic risk assessments of the potable water infrastructure.

Key Findings

Key findings from the assessments are presented along with the analytical framework for DRM adopted for this report and presented in section 5.

Institutional, Regulatory, and Policy Frameworks:

- *The WSS sector is inadequately represented in the DRM and CCA institutional, policy, and regulatory frameworks at both the regional and the national levels.* At the regional level, FOCARD-APS is not directly involved in the development of the main ongoing regional initiatives for DRM and CCA. At the national level, WSS institutions participating in DRM systems are not always the most appropriate or represent only a portion of the WSS sector.
- *Chronic financial shortfalls in the sector hinder the mainstreaming of DRM and CCA in WSS investments and practices.* The lack of sufficient budget allocations to meet sector investment and rehabilitation needs leads countries to defer the implementation of DRM and CCA measures. However, the assessment found concrete examples of DRM approaches and actions in the WSS sector, which are expanded upon in section 6.
- *DRM and CCA considerations are not commonly considered in pre-investment norms, construction codes, and standards for WSS infrastructure.* Resilient construction and reconstruction practices, which are key to the avoidance of vulnerability, are not implemented in any of the FOCARD-APS countries.
- *Professional societies and municipal associations provide useful avenues for strengthening sector capabilities in DRM and CCA in multiple ways such as providing a pool of trained, locally-based volunteers and consultants in cases of disaster, and providing ready access to local governments, especially to smaller, rural municipalities for capacity building as well as rapid response.*

Risk Identification:

- *The limited sector-specific risk information constrains relevant risk analysis for decision making.* Basic information regarding the location and characterization of the main WSS system components, effective monitoring of hydrometeorological variables, and coordinated climate and risk information-gathering systems are essential to adequately conduct hazard assessments and vulnerability and risk analysis. However, only a few utilities in the region keep updated cadastral maps and registries of infrastructure, and climate and risk information is often not available or shared with WSS institutions.
- *Knowledge of WSS systems and service interruptions caused by emergencies and disaster situations is almost nonexistent*. Analysis of the impacts of disasters on WSS system functionality and service form the basis of an actionable risk evaluation, though such analyses are very limited and have been conducted only on a pilot basis in a few utilities in Costa Rica and the Dominican Republic.

Risk Reduction:

- *Risk reduction is not highly prioritized in WSS sector policy frameworks and practices in FOCARD-APS countries.* This is in part due to a general misunderstanding and underestimating of the possible effects on WSS infrastructure.
- *The WSS sector lacks human and financial resources needed for risk reduction.* Only three countries' primary WSS service providers have dedicated DRM units.
- *Risk reduction has been piecemeal, but select lessons learned and examples of best practice have emerged*. Examples such as the wastewater treatment plant relocation decision in Managua, Nicaragua, or the corrective measures adopted in the Orosi aqueduct in Costa Rica are noteworthy experiences in risk reduction that could be replicated in other countries in the region. Those examples are expanded upon in section 6.

Preparedness:

- *Preparedness is a high priority among these countries, unlike other aspects of DRM*. Countries have traditionally focused on emergency response, and they tend to be better prepared to react to disasters than to gather risk evidence, plan, and implement risk reduction actions.
- *However, no country has mapped the WSS institutions that have sufficient capacity for disaster response.* In many cases, WSS disaster response is provided by institutions outside the WSS sector, there are no specific emergency coordination mechanisms for WSS, and disaster response plans and protocols are outdated and/or misaligned with national standards.
- *All seven countries studied have on-going projects covering DRM and/or CCA, co-financed by either the IDB or the World Bank (sometimes both) worth more than US$ 300 million.*

Financial Protection:

- *The lack of risk information prevents the development and utilization of financial instruments tailored to the WSS sector.*
- *Clear examples of financial protection and risk transfer remain to be developed in the WSS sector.*
- *The World Bank's Catastrophe Risk Deferred Drawdown Option loan (Cat-DDO) is a tool that has been used by four of the region's IBRD-eligible countries, designed to provide immediate liquidity in the case of disaster funding needs and ensure the preparation and maintenance of a national disaster risk management program.*

Resilient Reconstruction:

- *Temporary quick-fix reconstruction solutions to tackle urgent situations in the aftermath of an event have often become long-term unsustainable results.* This is caused by the lack of a

long-term vision coupled with the limited resources allocated to response processes, which together hinder the resilient reconstruction of WSS infrastructure.

Recommendations

A brief summary of the recommendations proposed for better integrating DRM and CCA considerations into the WSS sector is included below and developed further in in section 7.

Institutional, Regulatory, and Policy Frameworks

- *Promote Stronger Interinstitutional Coordination that Builds on Respective Strengths:* DRM and CCA in the WSS sector inherently entails multisectoral participation and involvement of major line ministries, service providers, the private sector, nongovernmental organizations, scientific institutions, and academia. Strong coordination between relevant agencies on the themes of WSS, DRM, and CCA is therefore required.
- *Identify Key Proponents and Champions:* The multiplicity of actors in the WSS sector complicates the definition and establishment of functions, responsibilities, and attributions. It also creates a lack of clarity in terms of who is responsible for prevention, preparedness, mitigation, and emergency response. The Dominican Republic is in the process of formalizing WSS sector roles through the promulgation of a WSS sector law that incorporates DRM.

Risk Identification:

- *Generate and Maintain Comprehensive Risk Information for Evidence-based Decision Making:* Updated cadastral maps, effective monitoring of hydrometeorological variables, and coordinated climate and risk information-gathering systems are needed to enable early warnings as well as the evaluation of risk, the (functional) vulnerability of WSS systems, or the exposure of WSS services to hazard and water variability.

Risk Reduction:

- *Integrate DRM in daily WSS service operations, and create specific units within service providers for DRM and CCA* by ensuring that operation and maintenance (O&M) plans include risk management considerations and by making risk-informed decisions on new sector investment. Nicaragua is in the process of developing master plans for drainage in urban areas to reduce risk to WSS services.
- *Promote integrated water resource management (IWRM) to address the growing challenge of water scarcity.* Effective IWRM can curb the worst of climate variability impact on water resources and WSS services, especially along the Dry Corridor that runs through these countries, by capitalizing on solutions to cope with the intensified cycle of drought and flood and the competition for increasingly scarce water resources. Costa Rica, for example, seeks to incorporate payment for environmental services mechanism to protect freshwater sources and supply basins.
- *Incorporate DRM and CCA criteria in pre-investment norms and technical codes for design and construction of WSS infrastructure.* The relocation of the waste water treatment plant for

Managua to a safer area after the would-be site was flooded during hurricane Mitch is a good example of a cost-effective decision for risk reduction. Cost-benefit studies showed that costly levees would be required to prevent flooding in the area.

Preparedness:

- *Regularly update existing plans and protocols and harmonize them with national standards,* so as to ensure a coordinated and effective response. Honduras has procedures in place for emergency prevention related to drinking water and sanitation, as well as an action plan for emergencies, all of which are updated regularly.
- *Raise public awareness about the risk of disaster and what to do when one strikes through media and schools program*. Generating understanding among the population is critical to help them reduce vulnerabilities and exposure to be better prepared in the event of a disaster.

Financial Protection:

- *Explore alternatives for disaster risk finance:* Developing sound risk-financing strategies for the WSS sector is essential, as they offer the benefit of protecting a government from future contingent liabilities should a disaster strike. Earthquake insurance helped a WSS utility in Southern Chile quickly replace infrastructure following 7.8 magnitude earthquake in 2010.
- *Rethink financing and budgeting of the WSS sector:* Rethinking subsidies and tariffs would be useful not only to reflect basic costs of operations, but also to cover risk-reducing investment needs.

Resilient Reconstruction:

- *Resilient reconstruction should be better integrated into DRM and CCA frameworks,* in order to prevent the reconstruction of previously existing vulnerabilities during emergency response efforts. The Honduran government has prepared guidelines to incorporate DRM processes in technical analysis of projects.
- *Promote redundancy of interconnected public services,* such as water, energy, and telecommunications. Having alternative options of water and energy supplies in case of a system failure improves response capacity and may be critical for service continuity during an emergency.

Regional Recommendations:

- *Capitalize on current regional initiatives to increase the likelihood that proposed DRM and CCA opportunities in the WSS sector are successful*. It is helpful to link initiatives to the agenda of a Central American Integration System (SICA) regional entity to help gain political traction.
- *Operationalize existing regional policies that promote DRM and CCA in the WSS sector.* Existing strategies offer opportunities to institutionalize the links at the nexus of DRM and WSS. SDC is supporting the harmonization of the PCGIR in Central American countries.

- *Harmonize methodologies, tools, instruments, and information* with the aim of developing a regional inventory of existing tools, as well as pursuing efforts to develop common methodologies, instruments, and regional expertise.
- *Encourage regional knowledge exchange and capacity building*, including capacity-building workshops for WSS service providers as well as scientific and academic institutions on probabilistic risk assessment methodologies such as the CAPRA Probabilistic Risk Assessment Program and the Public Infrastructure Engineering Vulnerability Committee (PIEVC).
- *Include DRM and CCA in sanitary and environmental engineering university curricula to build local DRM capacity.* Several institutions in the subregion are developing educational programs in collaboration with international partners.

Priorities and Opportunities for engagement

There is a clear need to deepen efforts to develop disaster and climate-resilient WSS services. An increased focus on DRM in the water and sanitation sector can contribute to saving lives and livelihoods, and can support poverty reduction by improving the resilience of communities. It can also help protect economic growth by ensuring reliable and resilient provision of WSS services. It is also a good place to start when planning for the impacts of climate change. Growing demand from countries and the possibilities afforded by new tools and techniques to better understand and manage risk provide a unique opportunity for engagement at the nexus of WSS with DRM and CCA to support Central American countries and the Dominican Republic in their path toward a more sustainable and prosperous WSS sector.

Building on the recommendations outlined above, a summary of key activities, prioritized by clients, which represent opportunities for engagement in each country and the region is presented in section 8 (Table 11).

Output Report

1. Purpose

The purpose of this economic and sector work (ESW) is to support the FOCARD-APS member countries[11] in improving the resilience of their water supply and sanitation (WSS) services. This report summarizes the findings from seven country-specific assessments carried out in 2013 and 2014 that characterize the national DRM and CCA frameworks and efforts made to reduce the vulnerability of WSS services to disasters and climate change. This activity also supports the World Bank strategy for enhancing DRM in Central America.[12]

This report has the following aims:

- Present a framework for assessing the efforts and progress made by countries in incorporating DRM and CCA into their WSS sector policy framework and practices.
- Characterize the enabling environment and effort to mainstream CCA and DRM in the WSS sector in the subregion and in each country.
- Identify common challenges confronting sector institutions in their efforts to ensure resilient service delivery.
- Disseminate key findings and prepare recommendations for short- and medium-term actions to strengthen national and regional sector capacity in CCA and DRM.
- Expand knowledge and understanding of CCA and DRM issues among WSS sector technicians and executives.
- Identify client priorities and opportunities for engagement at the nexus of DRM and CCA with WSS in Central America and the Dominican Republic.

This work represents the results of a comprehensive participatory process that contributed to building the analytical capacities of the institutions that form FOCARD-APS's Regional Thematic Group for Disaster Risk Management (RTG-DRM). It involved thorough document reviews and two rounds of country visits for data collection, as well as consultation with national and regional experts. The findings of all assessments were validated through national and regional workshops by the RTG-DRM. Regional learning exchanges and study visits were organized as part of this activity to provide policy makers with concrete examples of approaches and potential measures for addressing disaster risk challenges from a WSS service provision perspective and through a broader political and sectoral scope covering policy development, financing, capacity building, and institutional reform.[13]

[11] FOCARD-APS member countries are Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, and Panama.
[12] World Bank (2012). Programmatic Knowledge Services: "Enhancing Disaster Risk Management in Central America" (P145227).
[13] For example, technical assistance was provided through the CAPRA program (P144982) to the national WSS utilities of Honduras (SANAA) and Panama (IDAAN), for strengthening WSS utilities' institutional capacity to implement probabilistic risk assessments of the potable water infrastructure.

2. Background

Growth, Economic Outputs, and Poverty

Central America and the Dominican Republic consist of seven lower- to upper-middle-income countries that share many development challenges.[14] Some 44 percent of the region's population of 55 million lives below national poverty lines, as outlined in Table 1.[15] Over the last decade, this sharp inequality has remained essentially unchanged in the region, despite having shrunk across Latin America on the whole.[16] Regional economies are regularly and severely affected by shocks caused by natural hazards, including hydrometeorological ones (floods, cyclones, and landslides) and geophysical ones (earthquakes and volcanoes), which hamper the effective delivery of public services to the population.

Table 1. Population, Economic Output, and Poverty in Central America and the Dominican Republic

Country	Population (millions, 2013) Urban	Rural	Total	GDP per capita (current US$)	Share below national poverty line (%)
Costa Rica	3.7	1.2	4.9	10,180	22
Dominican Republic	8.0	2.4	10.4	5,879	41
El Salvador	4.2	2.2	6.3	3,830	30
Guatemala	7.8	7.6	15.5	3,480	54
Honduras	4.3	3.8	8.1	2,290	65
Nicaragua	3.5	2.5	6.1	1,850	43
Panama	2.6	1.3	3.9	11,040	26
Region	34.1	21.0	55.1	4,740	44

Source: World Bank, World Development Indicators.

An Overview of Water Resources Management

Central America and the Dominican Republic are increasingly affected by water scarcity. Central America could be generally considered a water-rich region, with some 723 billion cubic meters per year of fresh surface water and an average water availability per capita of approximately 28,000 cubic meters per year. With the exception of El Salvador, all the countries use less than 10 percent of the water resources that are available.[17] In contrast, the Dominican Republic is close to water stress levels,[18] with an average water availability per capita of 2,019 cubic meters per year.[19] Moreover, water scarcity is increasingly affecting the other countries in the subregion, driven by uneven spatial and seasonal water distribution, rapid population

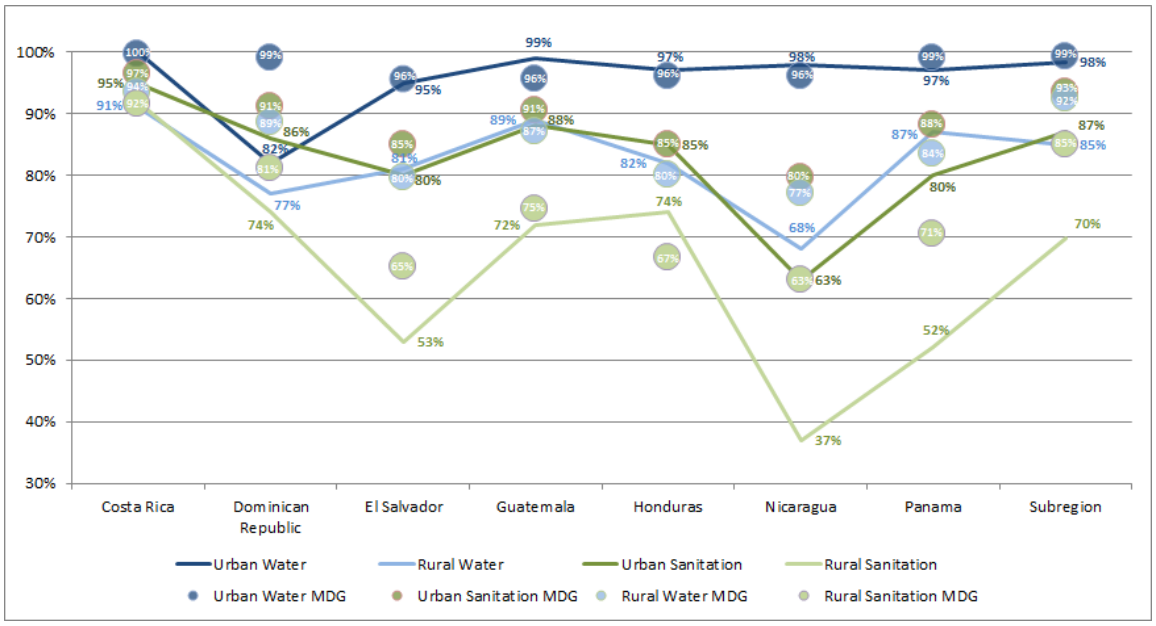
[14] Honduras and Nicaragua are IDA countries, whereas Costa Rica, El Salvador, Guatemala, Panama, and the Dominican Republic are IBRD countries.
[15] Data from World Bank Open Data, data.worldbank.org.
[16] Central America Overview, World Bank, www.worldbank.org/en/country/centralamerica/overview.
[17] Global Water Partnership, "Situación de los recursos hídricos en Centroamérica: hacia una gestión integrada", p. 28, www.gwp.org/Global/GWP-CAm_Files/SituaciondelosRecursosHidricos.pdf.
[18] An area is said to experience water stress when annual water supplies fall below 1,700 cubic meters per person, according to the 2012 UNESCO report *Managing Water Under Uncertainty and Risk*, http://www.unesco.org/new/fileadmin/MULTIMEDIA/HQ/SC/pdf/WWDR4%20Volume%201-Managing%20Water%20under%20Uncertainty%20and%20Risk.pdf.
[19] Food and Agriculture Organization, AQUASTAT, data available at www.fao.org/nr/water/aquastat/main/index.stm.

growth, increasing competition between the agricultural and industrial sectors, inadequate infrastructure, degradation of water quality, and extreme weather events, such as droughts and floods. Adaptation measures undertaken by utilities are often ad hock and short-term, despite the long term challenges posed by increasing water scarcity.[20]

An Overview of Water and Sanitation Coverage and Service Provision

Central American countries and the Dominican Republic have made significant progress toward the Millennium Development Goal (MDG) targets related to water supply and sanitation, as summarized in **Error! Reference source not found.**. Together, 89.8 percent of the population of Central America and the Dominican Republic had access to an improved drinking water source, and 76.9 percent of the population had access to improved sanitation facilities.[21] However, substantial differences emerge between countries in terms of the progress achieved. As of 2012, only Honduras had met its MDG sanitation target. Costa Rica, El Salvador, and Guatemala remained on track to meet their targets, but progress was considered insufficient in the Dominican Republic, Nicaragua, and Panama. For drinking water, El Salvador, Guatemala, Honduras, and Panama have met their MDG targets, while Costa Rica and Nicaragua remain on track to do so; the Dominican Republic had the largest gap to close, with coverage rates falling in urban areas progressively since 2000. All FOCARD-APS countries need to close the persistent gaps in coverage between urban and rural areas and across income quintiles.[22] Moreover, coverage gains have, in some cases, followed territorial expansion into hazard-prone areas, translating to increased exposure and vulnerability of water supply and sanitation infrastructure and services. Therefore, progress is in jeopardy, with the potential of being adversely affected by climate and disaster risk

Figure 1. Urban and Rural WSS Coverage Disparity, MDG Progress, 2014



[20] World Bank, Climate Change and Urban Water Utilities: Challenges & Opportunities, 2010, http://www.wsp.org/sites/wsp.org/files/publications/climate_change_urban_water_challenges.pdf.
[21] WHO/UNICEF JMP, *Progress on Drinking Water and Sanitation, 2014 Update*.
[22] World Bank, *Monitoring Country Progress in Water and Sanitation (MAPAS) Regional Synthesis 2014*.

Source: WHO/UNICEF JMP, Update 2014; data 2012.

The Impact of Climate Events in Central America and the Dominican Republic

Central American countries and the Dominican Republic are considered some of the countries most vulnerable to climate-related risk, according to the 2015 Global Climate Risk Index.[23] Given its recent history, Honduras is considered the country most affected by extreme weather events. The Dominican Republic, El Salvador, Guatemala and Nicaragua are also among the global top 12.[24] Table 2 displays the country rankings and total losses to extreme weather events in the period from 1994 to 2013.

Table 2. Global Climate Risk Index (CRI) Ranking and Average Annual Losses of Central American Countries and the Dominican Republic, from 1994 to 2013[25]

Global ranking (1994–2013)	Country	Total losses in millions (US$ PPP)	Losses per unit GDP (%)
1	Honduras	813.56	3.30
4	Nicaragua	301.75	1.71
8	Dominican Republic	274.06	0.37
9	Guatemala	477.79	0.62
12	El Salvador	335.72	0.933
60	Costa Rica	112.14	0.268
90	Panama	23.97	0.071

Source: Global Climate Risk Index 2015, Germanwatch

3. The Climate and Disaster Risk Context

Understanding the Drivers of Climate and Disaster Risk

Understanding the drivers of climate and disaster risk is critical when aiming to evaluate what can be done to strengthen the resilience of WSS infrastructure and service delivery. As presented in Figure 2, risk is determined by the following factors:

(i) **hazard**, the potential occurrence of a natural event that may cause losses of life, as well as damage and loss to property, service provision, and environmental resources. Some naturally occurring events or phenomena, be they tropical cyclones, floods, droughts, landslides, earthquakes, or volcanic eruptions are considered hazards depending on the potential to generate damages or losses. A changing climate leads to changes in the frequency, intensity, spatial extent, duration, and timing of extreme weather and climate events, and can result in unprecedented extreme weather and climate events. The character and severity of

[23] Developed by Germanwatch, the Climate Risk Index (CRI) analyzes the quantified impacts of extreme weather events—in terms of both fatalities and economic losses. More specifically, it measures meteorological events such as tropical storms, winter storms, severe weather, hail, tornados, and local storms; hydrological events such as storm surges, river floods, flash floods, and mass movement (landslide); and climatological events such as freezes, wildfires, and droughts.

[24] Germanwatch: Global Climate Risk Index 2014.

[25] The Global Climate Risk Index is generated from multiple factors, which include economic losses and deaths attributed to the events.

impacts from extreme events depend not only on the extreme themselves but also on exposure and vulnerability;

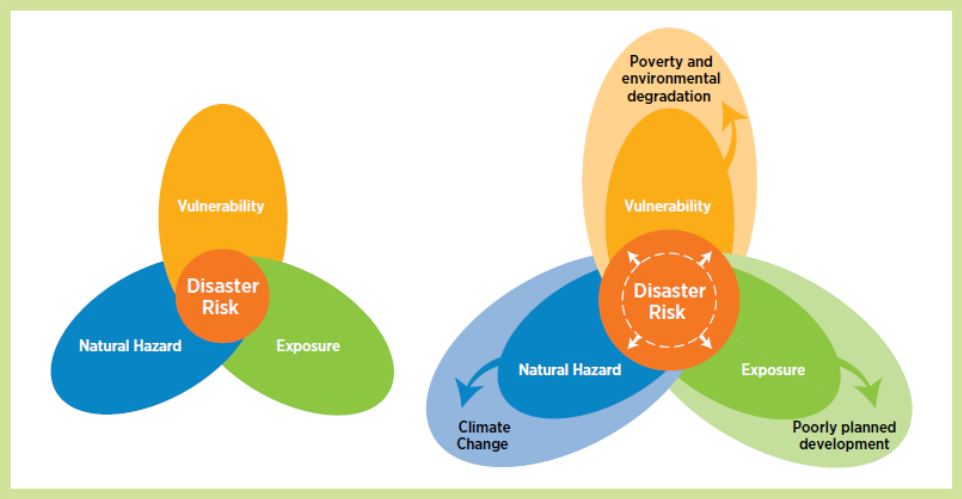
(ii) **exposure,** which is determined the presence of people, livelihoods, environmental services and resources, infrastructure, and economic, social, and cultural assets, in places that could be adversely affected. Such exposure is always human induced and can be aggravated by rapid population growth and territorial expansion into hazard-prone areas,[26] environmental degradation, lack of regulation, and/or lack of enforcement of safe territorial development and building practices; and

(iii) **vulnerability,** which is the characteristic of a community, system, or asset making it susceptible to be adversely affected by the damaging effects of some natural events. The vulnerability depends on economic, social, geographic, demographic, cultural, institutional, governance, and environmental factors. In the context of the WSS sector, the physical vulnerability of a system can stem from poverty, the management model, the regulatory framework, or institutional factors that increase the damaging effects of a natural hazard event (e.g., poor design, lack of maintenance, weak enforcement capacity, fragmented post-disaster operational procedures).

Exposure, vulnerability and hazardous events are the factors that shape and modify the risk and can alter the impacts of disasters. Climate and weather hazards, exacerbated by natural climate variability and climate change, can interact with local exposure factors (for example, the location of settlements in high risk areas) and vulnerability conditions (such as environmental degradation and limited access to economic resources) access, resulting in the creation or increased disaster risk conditions , as outlined in Figure 2.

[26] It is important to emphasize that unplanned urban development and territorial expansions into areas that are hazard-prone contribute to the exposure of the WSS infrastructure developed to serve the population living in unsafe areas. Given that in many developing countries, WSS infrastructure and services follow urban development, unsafe urban planning and development can have very significant implications for the WSS infrastructure and public assets that serve such communities. Such a dynamic is important to account for, considering that infrastructure represents significant sunk costs and potential to lock-in development for years to come.

Figure 2. The Role of Natural Hazards, Exposure, and Vulnerability in Disaster Risk



Source: World Bank, 2013. *Building Resilience: Integrating Climate and Disaster Risk into Development.*

Vulnerability to climate change appears to be on the rise in Central America and the Dominican Republic. In recent years, an increase in temperature coupled with significant changes in precipitation and rainfall distribution patterns have been observed.[27] The number of dry days during the rainy season has increased as has the number of days of extreme precipitation. In the past 60 years, roughly 10 extreme drought events, which lasted between 12 and 36 months, have caused significant socioeconomic impacts in Central America, principally along the Dry Corridor (*Corredor Seco*), a strip of land along the Pacific coast between Costa Rica, Nicaragua, Honduras, El Salvador, and Guatemala, the location of some of the most severe social, environmental, economic, and productive risk scenarios. Projections based on different global emission scenarios indicate that temperatures will increase in Central America and the Dominican Republic, from 0.9–2.8°C by 2050 to 1.2–4.1°C by 2080, and that annual precipitation will decrease by 8–18 percent by 2050 and 27 percent by 2080. According to the Central American Commission for Environment and Development (CCAD), annual precipitation in the Dominican Republic will decrease 11 percent by 2050 and 57 percent by 2100. The frequency and intensity of extreme climate events is likely to increase. In the next 20 years, forecasters expect a minimum of three to five droughts and a number of tropical storms higher than those that have occurred in the last 20 years.[28] The availability of fresh or potable water in the coastal marine regions is also expected to be affected by the salinization of aquifers caused by eventual sea-level rise.

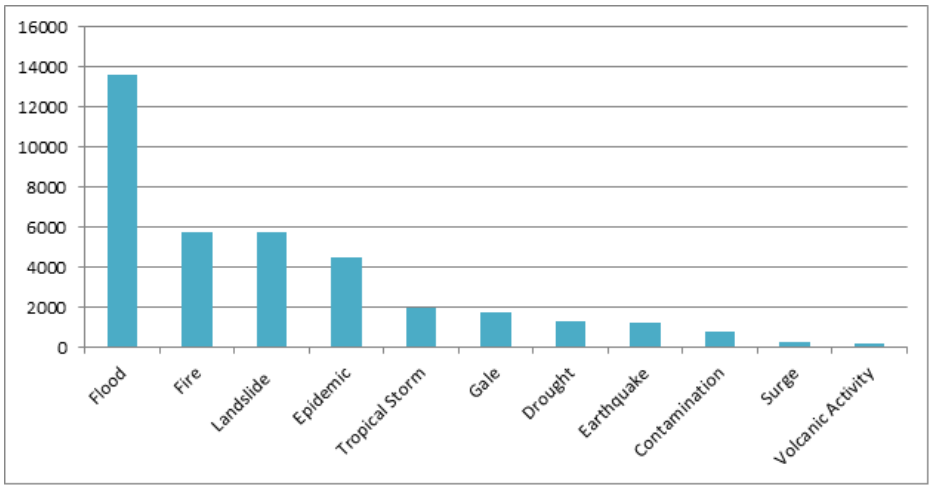
Understanding the Impact of Disaster Events in Central America and the Dominican Republic

Central American countries and the Dominican Republic are highly exposed to natural hazards, a major driver of their respective risks. Some of the more recent events that have affected Central America and the Dominican Republic include the El Niño phenomenon of 1997; Hurricanes Mitch and Georges in 1998; Stan and Beta in 2005; Felix, Noel, and Olga in 2007;

[27] Study of climate parameters evolution over the past 40 years (1961-2003). Aguilar et al. 2005
[28] Inventory system of the effects of disasters, available at www.desinventar.org/.

and Ida in 2009; and Tropical Depression 12E in 2011. In addition, the majority of these countries are also affected by floods, landslides, droughts, tropical cyclones, earthquakes, and volcanic activity. Figure 3 summarizes the historical occurrence of hazardous events throughout the region for the period of 1915-2011 based on DesInventar data.

Figure 3. Number of Events by Hazard Type in Central America (1915–2011)



Source: DesInventar 2012.

Events such as earthquakes, tropical cyclones, and volcanic eruptions have caused the greatest losses per single event in Central America and the Dominican Republic. However, floods and landslides have generated localized recurrent impacts of high frequency, which cumulatively could translate into even greater comparative losses than those associated with large-scale events. Tropical cyclones affecting Central America and the Dominican Republic originate primarily in the Atlantic basin though can arise along the Pacific coast as well. For Central America, the highest threat is along the Caribbean coast, peaking in Belize, Dominican Republic and on the northern coast of Honduras and diminishing southward along the eastern coast of Nicaragua. The tropical cyclone threat declines significantly along the Costa Rican and Panamanian coasts (Figure 4.) For seismic and volcanic hazards, (Figure 5) the most intense seismic activity occurs along the entire Pacific coast—from Mexico to Costa Rica. Owing to its location, the Dominican Republic is considered one of the countries with the highest seismic risk in the Caribbean, since its territory lies in the Caribbean–North American plate boundary zone.

Figure 4. Tropical Cyclone Threats for Central America, Based on Expected Wind Speed (Return Period of 100 Years)

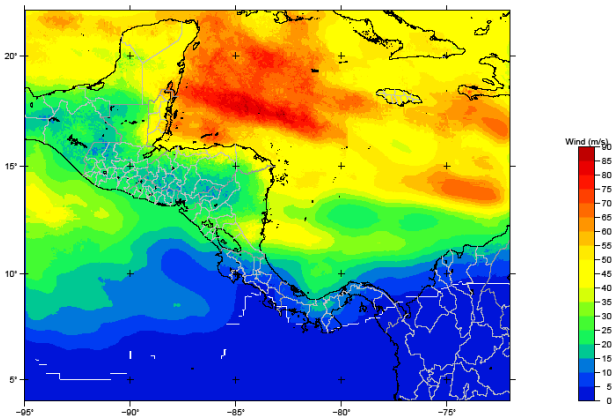
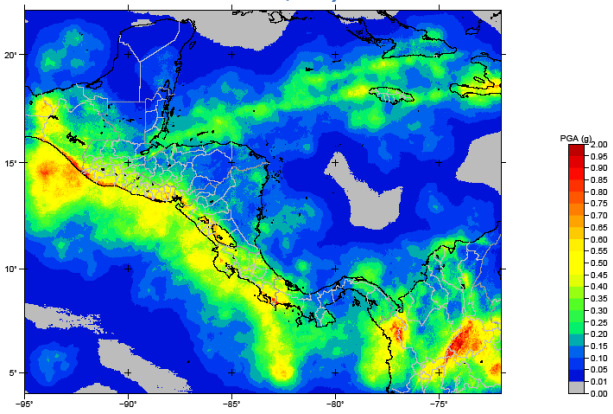


Figure 5. Seismic Threats to Central America, Based on Expected Peak Acceleration (Return Period of 2,475)



Source: Caribbean Catastrophe Risk Insurance Facility (CCRIF), 2014, *Central America Catastrophe Risk Profiles*.

Increased climate variability exacerbates the cycle of droughts and floods in Central America and the Dominican Republic.[29] More prolonged droughts have been experienced in El Niño periods and more intense cold fronts, tropical storms, or hurricanes[30] in La Niña periods. In Central America in particular, annual floods affect all countries,[31] while areas along the Dry Corridor experience water stress.[32] As presented in Figure 6, some 7.5 percent of the Dry Corridor is classified as a zone with potentially severe drought effects, 50.5 percent is classified as a zone with high drought effects, while the remaining 42 percent is classified as a zone with low drought effects.[33] Honduras contains the largest portion of the Dry Corridor (42.1 percent of total area), while the entire territory of El Salvador falls within the corridor.[34] Droughts pose a significant threat, by reducing crop yields, increasing pressure on water used for irrigation, and threatening urban and rural water supplies.

[29] These droughts are cyclical and closely linked with El Niño–Southern Oscillation (ENSO) periods. (FAO, 2012. *Regional Strategic Framework for Climate Risk Management in the Agricultural Sector of Central America's Dry Corridor*.)

[30] CCAD/SICA (2011). "Estrategia Regional de Cambio Climático – Documento Ejecutivo."

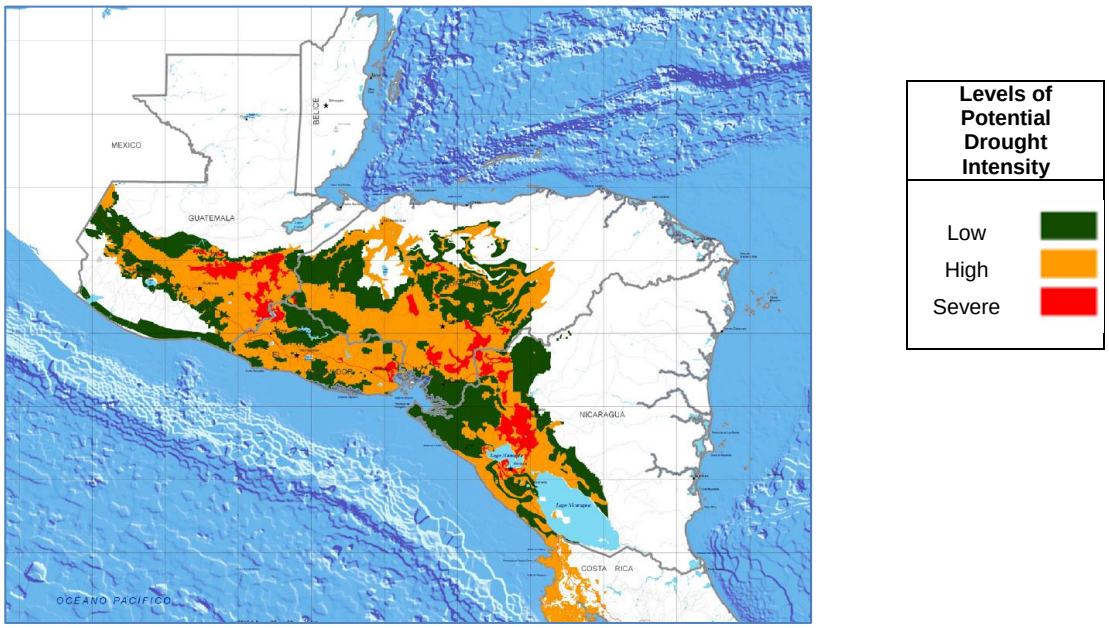
[31] United Nations Office of Disaster Risk Reduction, "Regional Report on the State of Vulnerability and Disaster Risks." www.info-gir.org/documentos/rar/files/assets/downloads/publication.pdf.

[32] The Dry Corridor extends across a 160,000 km^2 area (30 percent of Central America's territory), running from low elevation areas through the foothills (800 meters) along the Pacific watersheds of Guatemala, El Salvador, Honduras, Nicaragua, and parts of Costa Rica. (FAO, Central America Drought Update, www.fao.org/giews/english/shortnews/CA19092014.pdf).

[33] Severe drought: low rainfall (800–1,200 mm per year), over six dry months, high potential evaporation, average exceeding 200 mm per month). High drought: mean rainfall (1,200–1,600 mm per year, between 4 and 6 dry months. Mean evapotranspiration averaging roughly 130 mm/month). Low Drought (high rainfall (1,600-2,000 mm / year), between 4 and 6 dry months. Low evapotranspiration averaging less than 100 mm/month)

[34] Areas considered part of the Dry Corridor were calculated based off of the following equation: (a) dry months multiplied by (b) precipitation and (c) Holdridge life zones system – a global bioclimatic scheme for the classification of land areas

Figure 6. Drought Map of the Dry Corridor in Central America



Source: FAO *Characterization of the Central American Dry Corridor* (December 2012).

Disaster Impacts on Infrastructure and WSS Service Provision

From 1990 to 2014, close to US$17.5 billion in disaster-related damages were incurred in Central America and the Dominican Republic.[35] At the country level, the impacts are severe. In El Salvador in 2011, for example, direct losses resulting from the occurrence of natural phenomena were equivalent to 8 percent of the total public and private investments of the country.[36] The main extreme events include the El Salvador earthquakes of 2001 and the November 2012 earthquakes in Guatemala, which caused combined damages and losses equivalent to 12 percent and 36 percent of GDP, respectively. Hurricane Mitch (1998) is estimated to have set back Honduras's development by 30 to 40 years; damages to drinking water and sanitation infrastructure amounted to US$58 million with an estimated reconstruction cost exceeding US$196 million. In the Dominican Republic, Tropical Storm Noel caused estimated total damages and losses to the WSS sector equivalent to US$24 million, while in El Salvador, a 2001 earthquake caused damages equivalent to US$23 million.[37] Table 3 provides additional information on total damages and losses due to selected disaster events, disaggregated between national and WSS sector damages and losses.

Table 3. Damage and Costs by Selected Disasters in Central America and the Dominican Republic (in 2010 US$ millions)

	Disaster		Persons affected [a]	Direct damages	Indirect damages	Total damages

[35] This figure accounts for total damages incurred from climatological, geophysical, hydrological, and meteorological disasters between 1990 and 2014 in Costa Rica, the Dominican Republic, El Salvador, Guatemala, Honduras, Nicaragua, and Panama (Em-Dat, 2015, www.emdat.be).
[36] UNISDR (2013), *Global Assessment Report* (GAR).
[37] According to CEPAL studies referenced in ECHO (2012), "Documento Regional –América Central– Séptimo Plan de Acción DIPECHO en la Región Centroamericana" (BORADOR).

	Disaster		Persons affected [a]	Direct damages	Indirect damages	Total damages
Costa Rica [b]	Hurricane Cesar (1996)	Total	570,000	531.70	439.12	970.82
		WSS	No information	13.90	0.14	14.04
	Hurricane Mitch (1998)	Total	No information	71.99	49.91	121.90
		WSS	No information	1.07	0.13	1.20
El Salvador	Hurricane Mitch (1998)	Total	347,169	226.66	292.63	519.29
		WSS	No information	1.87	1.34	3.21
	Earthquakes (2001)	Total	1,412,938	1156.14	818.95	1975.34
		WSS	575,626	23.03	5.42	28.45
	Tropical Storm Ida (2009)	Total	122,816	214.24	105.87	320.12
		WSS	1,085,619	12.94	7.05	19.99
Guatemala	Pacaya Volcano and Tropical Storm Agatha (2010)	Total	338.543	602,60	368,85	989.45
		WSS	No information	10,15	4,51	14.66
	Hurricane Stan (2005)	Total	3.500.000	464.14	625.22	1089.36
		WSS	1.015.603	6.96	6.33	13.29
	Hurricane Mitch (1998)	Total	750.000	385.09	615.76	1000.85
		WSS	No information	14.05	7.49	21.54
Honduras	Hurricane Fifí (1974)	Total	500,000	No information	No information	681.29
		WSS	No information	No information	No information	16.81
	Hurricane Mitch (1998)	Total	No information	2,004.7	1,788.9	3,793.6
		WSS	No information	50.9	7.0	57.9
	Tropical Depression 12E (2011)	Total	725,155	117.6	86.7	204.05
		WSS	No information	No information	No information	1.02
Nicaragua	Floods (1982)	Total	No information	No information	No information	805.85
		WSS	No information	No information	No information	33.94
	Hurricane Joan (1988)	Total	No information	No information	No information	1431.07
		WSS	No information	No information	No information	14.49
	Hurricane Mitch (1998)	Total	867,752	569.71	430.83	1000.55
		WSS	1,075,00	11.14	3.14	14.28
Dominican Republic	Hurricanes David and Federico (1979)	Total	1,200,000	1733.38	757.04	2490.43
		WSS	No information	15.02	No information	15.02
	Hurricane Georges (1988)	Total	8,250,000	2538.66	1188.21	4043.79
		WSS	No Information	14.20	16.04	30.24
	Tropical Storm Noel (2008)	Total	6,037,871	257.19	288.01	444.74

Source: ECLAC (2011), "Economics of climate change in Central America – Summary."
Note: Post disaster evaluations were not identified for Panama and therefore are not reflected in this table. U.S. dollar figures correspond to constant 2010 U.S. dollars.
a. Persons reported as affected in the WSS category correspond to those who witnessed deteriorated or suspended WSS services caused by a disaster. This figure however does not necessarily reflect those directly affected by the disaster.
b. The MIDEPLAN report, titled "The Economic Impact of Natural Events and Extreme Anthropic in Costa Rica, 1988–2009", reported that urban and rural pipelines suffered estimated damages of US$45,403,237, between 1991 and 2009.

Hydrometeorological events such as excess rainfall, floods, and hurricanes generate the most frequent natural disasters in Central America and the Dominican Republic and have increased in frequency and intensity in recent years. Such events can damage water intakes, equipment, and assets as well as water distribution and sewerage networks; disrupt the electricity supply powering WSS systems; cause drainage issues and combined sewer overflows; inundate water and sewage treatment facilities beyond capacity; and reduce the quality of raw water at intakes, representing a challenge for treatment facility managers seeking to produce high-quality potable water. Earthquakes are singular events that can have very high impacts on WSS infrastructure and service delivery. Besides the damage to buildings, tanks,

treatment plants and any surface infrastructure generated by earthquake vibration, an additional potential impact includes the possibility of ground failure due to liquefaction[38] and ground deformation, which can have very significant adverse impacts on pipe networks in particular.[39] It is important to note that the damages and economic losses incurred by the WSS sector are difficult to quantify and thus appear to be a small proportion of the total disaster-induced damages at the national level. The fact that they are reported together with other infrastructure losses or basic services often masks the serious implications of the interruptions and deteriorations in WSS services for the region's health and social costs to end beneficiaries as well as economic development (e.g., tourism, productive, and commercial activities), which are considered the indirect—but at times, more significant—impacts of disaster.

4. Shared Challenges

4.1 Endogenous Challenges

The WSS Service Provision Challenge

Considerable gaps remain in securing efficient provision of WSS services throughout the subregion, with the greatest gaps among the urban poor and in rural areas, as summarized in figure 1. Even though the Central American countries and the Dominican Republic have made significant progress, substantial differences emerge between them in terms of the coverage achieved. All the countries need to close persistent gaps in coverage between urban and rural areas and across income quintiles in order to universalize WSS services. Even where WSS services are provided, their quality remains poor. Services are often unreliable—continuity of supply, drinking water quality, and sanitation standards are not guaranteed. Main urban service providers report efficiency indicators below regional and global benchmarks, and only a few service providers integrate CCA and DRM measures into their operational plans.[40] The problems are exacerbated in rural areas, where public investment programs in WSS do not consider CCA and DRM measures while over 28 percent of rural water systems run out of water during the dry season.[41] On-site sanitation continues to be the predominant solution. Only 32 percent of the population is connected to a sewerage system, and just 31 percent of the wastewater collected is treated before being discharged to water

[38] Primary classifications of ground failures caused by liquefaction include (i) lateral spread, (ii) ground oscillation, (iii) flow failure, and (iv) loss of bearing strength. Lateral spreads involve lateral displacement of large, surface blocks of soil, while ground oscillation can be characterized as upper soils oscillating back and forth and up and down in the form of ground waves. Flow failures represent the most catastrophic consequences of ground failure and involve the displacement of large masses of soil tens of meters and sometimes result in the complete liquefaction of soil. Loss of bearing strength results when the soil supporting a building or structure liquefies and loses strength, and thereby results in the structure tipping.

[39] An example of a high-impact earthquake is the April 1991 earthquake in Limon, Costa Rica. According to government estimates, damages to the WSS infrastructure amounted to approximately US$40.2 million (2014 value), representing an estimated 12.5 percent of total damages (Costa Rica Comisión Nacional de Emergencias; Banco Central de Costa Rica; and *Measuring Worth 2015*).

[40] *Monitoring Country Progress in Water and Sanitation* (MAPAS) 2014.

[41] SIASAR (2015). Illustrative estimate based on 6,450 rural WSS systems registered in SIASAR across Honduras, Nicaragua, and Panama.

bodies.[42] Sanitary sludge management is almost nonexistent in the region.[43] Moreover, coverage gains have, in some cases, followed territorial expansion into hazard-prone areas, translating to increased exposure and vulnerability of water supply and sanitation infrastructure and services. Going forward, reaching the population without access may often require continuing to build infrastructure in such areas. Therefore, progress is increasingly in jeopardy, with the potential of being adversely affected by climate and disaster risk.

The Financing Gap

The WSS sector has traditionally been underrepresented in national budgets, and current financial outlays appear insufficient to produce the major investments required to achieve the WSS-related targets set by the national governments. An annual gap of US$864 million has been estimated between current investment and the level needed to meet medium-term national targets for WSS in El Salvador, Honduras, and Panama.[44] In addition, aging water infrastructure and deteriorating networks represent major risks for the near future. Many existing systems, which were built decades ago, are reaching the ends of their life cycles and require repairs and/or replacements to maintain current service levels. Indeed, many public utilities and service providers lack an inventory of their infrastructure stock and assets. Across the region, tariffs are set low and fail to cover operating budgets, capital costs, and depreciation of infrastructure. Countries have yet to consolidate strategic planning mechanisms to estimate and track investments in the WSS sector, which continue to depend on external financing. Such shortfalls hinder capabilities as well as efforts to determine where to strategically invest to reduce risk and build the resilience of WSS infrastructure and service delivery.

The Institutional Challenge

The WSS sector in Central America and the Dominican Republic requires strong water governance and coordinated efforts to promote greater resilience. Indeed, governments of the subregion have made some progress, as evidenced by the creation of the Central American and Dominican Republic Forum for Potable Water and Sanitation (FOCARD-APS by its Spanish acronym) under the auspices of the Central American Regional Integration System (SICA) in 2004 to support national commitments to broaden WSS services. The FOCARD-APS develops regional approaches to common challenges, encompassing initiatives that support institutional, technical, and financial strengthening of WSS sector agencies, helping them overcome challenges in their respective countries. This is an important first step, though the allocation of roles and responsibilities between regional, national, and municipal actors as well as between public administrators, regulators, and utilities are often ill defined, resulting in a convoluted structure of institutional roles, responsibilities, and capacities. For example, although all Central American countries share at least one basin with their riparian neighbors, no single joint or coordination agreement on the use of water in these shared basins exists. Annex 1 provides a

[42] FOCARD-APS (2013). "Regional Diagnostic on Wastewater and Excreta Management in Central America and the Dominican Republic."
[43] LatinoSAN 2013, Mexico and Central America Sub-Region—Analysis of the Sanitation Sector, http://www.latinosan.info/informes/sub-regiones/norte-y-centro-america/linea-de-base/acceso-universal-a-servicios-de-saneamiento-sostenibles/.
[43] WB, Monitoring Country Progress in Water and Sanitation (MAPAS) Regional Synthesis 2014.
[44] World Bank, *Monitoring Country Progress in Water and Sanitation (MAPAS) Regional Synthesis 2014*.

brief summary of the WSS and DRM institutional landscape in Central America and the Dominican Republic, at both the national and the regional levels.

4.2 Exogenous Challenges

The Water Security Challenge

The Central American countries and the Dominican Republic are increasingly affected by water scarcity, which is driven by unplanned urbanization and rapid population growth, inadequate infrastructure, increasing competition with the agricultural and industrial sectors, degradation of water quality, significant water losses and water waste by consumers,[45] and adverse effects of extreme weather events such as droughts and floods. Groundwater resources are facing overexploitation in Guatemala, El Salvador, and Nicaragua, where many aquifer levels are dropping at a rate of 1 meter per year,[46] though data for the isthmus are incomplete. In particular, water scarcity has become an issue in the Dominican Republic, El Salvador, and other specific areas along the Dry Corridor. It presents a growing challenge elsewhere in the region, owing to irregular spatial distribution and seasonal fluctuations of precipitation. Two thirds of the population lives in the Pacific watershed, which drains only 30 percent of the surface water but has seen growing demand for water with urbanization and economic growth.

Water Variability Due to a Changing Climate

Increased climate variability in Central America and the Caribbean accentuates the cycle of droughts and floods, many of which are provoked principally by cold fronts, tropical storms, or hurricanes.[47] More prolonged droughts in El Niño periods and more intense rains, hurricanes, and storms in La Niña periods have been experienced. In Central America in particular, annual floods affect all countries in the region, while areas experiencing periodic water shortages are beginning to experience more chronic levels of scarcity (i.e., in El Salvador and Guatemala) and for others, drought is becoming a more regular occurrence (i.e. in Honduras and Nicaragua).[48] Both floods and droughts compromise water resources quantity and quality. Coupled with limited storage facilities that might mitigate the effects of seasonality, they produce significant water management challenges, particularly in guaranteeing a steady, high-quality water supply for households and farmers.

Socioeconomic Impact of Climate Change and Disasters

Post-disaster shortages and outages in WSS services can adversely impact households by increasing health care spending to treat waterborne illnesses as well as reducing productive hours of household members who consequently spend more time collecting water, caring for the

[45] Central America has the highest per capita consumption in the region (MAPAS 2014).
[46] Global Water Partnership-Central America, "Groundwater in Central America: Its Importance, Development and Use, with Particular Reference to Its Role in Irrigated Agriculture," www.iwmi.cgiar.org/Publications/CABI_Publications/CA_CABI_Series/Ground_Water/protected/Giordano_1845931726-Chapter6.pdf.
[47] CCAD/SICA (2011), "Estrategia Regional de Cambio Climático – Documento Ejecutivo."
[48] United Nations Office of Disaster Risk Reduction, "Regional Report on the State Disaster Vulnerability and Risks," www.info-gir.org/documentos/rar/files/assets/downloads/publication.pdf.

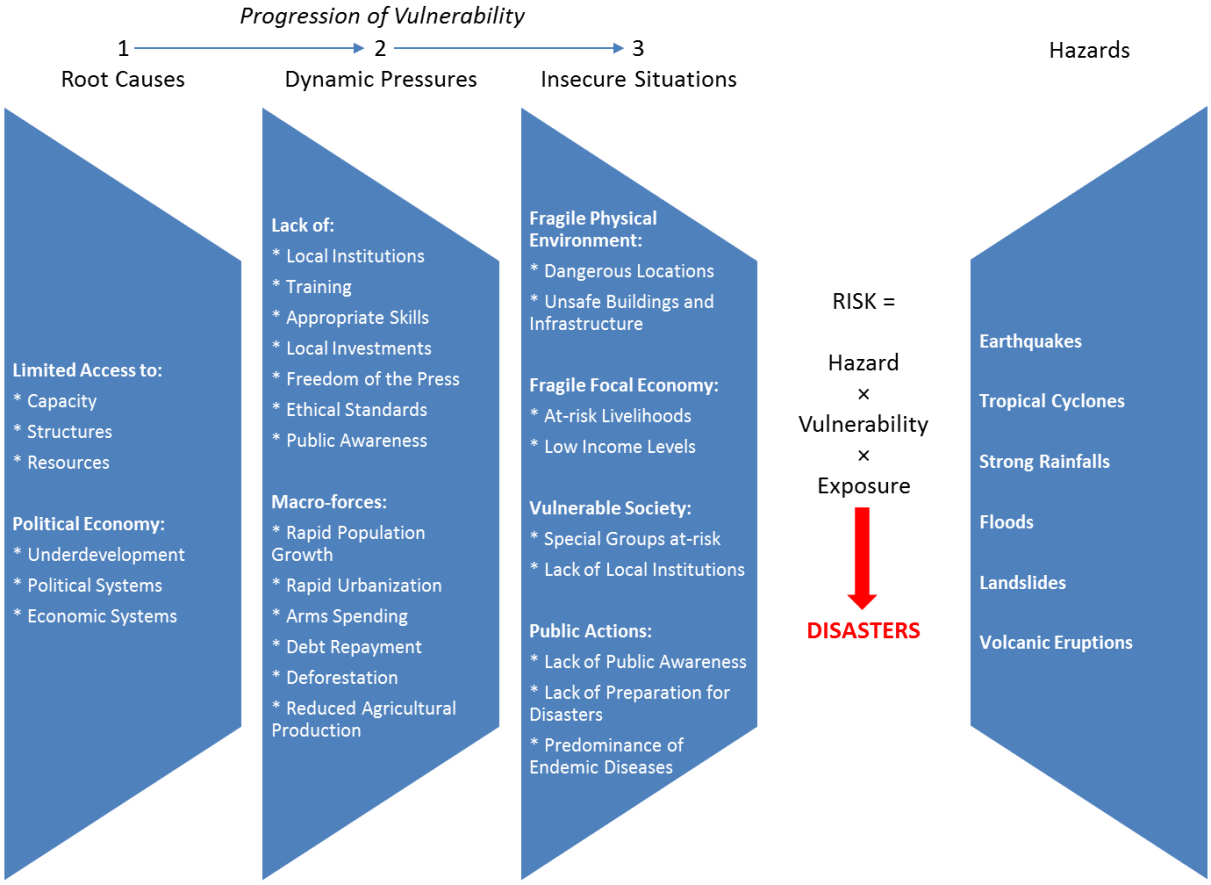
sick, or not attending school. Earthquakes are significant in the potential damages they can effect, as demonstrated in the Managua, Nicaragua earthquakes (1972), which left 90 percent of the city's population without water even one week after the event[49] and the 1976 Guatemala earthquake, which required around $12 million in replacement costs for WSS infrastructure. Inundation of water and sewage treatment facilities can further compromise the quality of treated water and effluent, with combined sewer overflows presenting serious health implications and environmental damage. These indirect losses are often masked as losses in other sectors (e.g., health, education, and environment) or assumed by households, often affecting women and children disproportionately. In addition, droughts can have significant impacts on food security and agricultural production, the primary source of income for many of the most vulnerable in Central America and the Dominican Republic. In Honduras and Guatemala alone, nearly 1 million households sustain themselves through subsistence farming and are the least prepared to cope with periods of extreme drought.[50]

Political Economy and Decisions from Related Sectors

Decisions made in other sectors can have direct and indirect consequences on WSS services.[51] Understanding of constituent risk factors and processes that occur at different levels and intensities, ranging from macro processes associated with existing economic and political systems, to micro processes regarding the characteristic the process of occupation of urban land related to the functioning of the market land and urban income, for example provides a trough out understanding of risk factors. The scheme in Figure 7 shows a conceptual model where the progression of risk factors are the result of unsafe dynamic pressures, linked to the forms or models development on a macro and micro level.[52] Therefore, resilient WSS infrastructure development and management inherently entails comprehensive and multisectoral understandings and approaches. Endogenous and exogenous political, economic, social, cultural, environmental contexts and challenges derive over time in the accumulation of exposure and vulnerability factors in the sector. Decisions in related sectors, such as agriculture, land use management, urban development, mining, and energy production, affecting the overall vulnerability conditions of the WSS.

[49] Rojahn, Christopher. "The Managua, Nicaragua Earthquakes of December 23, 1972." Abridged version of United States Geological Survey (USGS), "Earthquake Information Bulletin, September-October 1973, Volume 5, Number 5." http://earthquake.usgs.gov/earthquakes/world/events/1972_12_23.php.
[50] Acción Contra el Hambre (2010).
[51] UNESCO (2012). *Managing Water under Uncertainty and Risk. The United Nations World Water Development Report 4. Volume 1.*
[52] Dynamic pressures also operate the component of hazard, the clearest example is the degradation environmental (deforestation, soil loss, among others) which leads, almost inevitably, an increase in the probability of occurrence and / or increases the potential energy released by phenomena considered dangerous, such as landslides and floods.

Figure 7. "Pressures" that Result in Disasters: The Evolution of Vulnerability

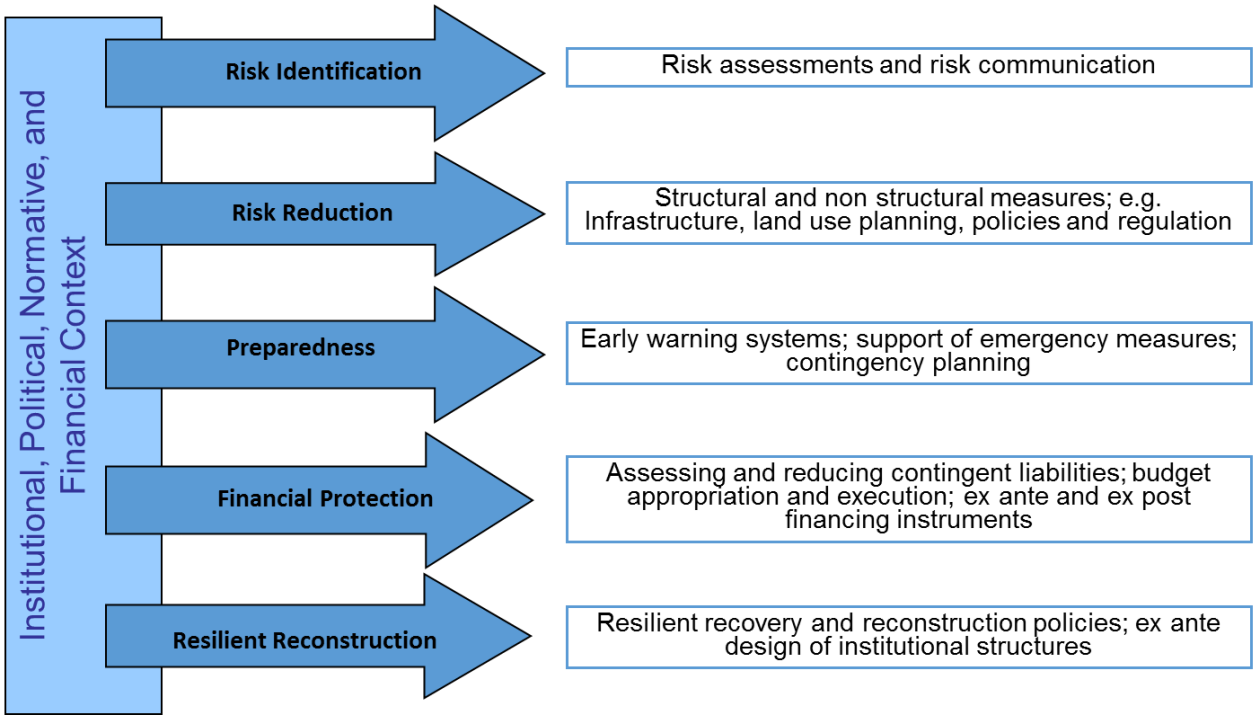


Source: Adapted from Blaikie et al., 1994.

5. Analytical Framework

The framework used to assess the status of the incorporation of DRM and CCA in WSS sector policy frameworks and practices is shown in Figure 8. It is based on the framework proposed in "The Sendai Report: Managing Disaster Risks for a Resilient Future," which was adapted for application to the WSS sector and validated by the RTG-DRM.

Figure 8. Disaster Risk Management Framework



Source: Ghesquiere and Mahul (2010). *The Sendai Report: Managing Disaster Risks for a Resilient Future.*

The institutional, policy, regulatory, and financial framework set the foundation for enabling measures required on multiple fronts to mitigate or address the comprehensive challenges represented by disaster risk. Therefore it is essential to understand how the framework enables or encumbers those measures in the WSS sector. To this end, the analysis of the framework was deepened in five strategic areas for climate and disaster risk management:

1. **Risk Identification:** Understanding risk is the first step in decision making. The assessment evaluates measures taken by countries to identify and quantify the underlying drivers of risk, which entail assessing climate and disaster risk, generating information on the effects of the most relevant natural hazards for decision making, and communicating such risks to citizens and institutional stakeholders.
2. **Risk Reduction:** With such an understanding, governments and service providers can implement appropriate and informed measures to address and mitigate such risks, taking into account the technical, human, and financial resources available. Measures include enacting policies, improving planning, and enforcing regulations to reduce exposure and improve the current vulnerability profiles of WSS infrastructure.

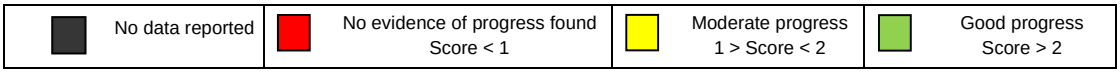
3. **Preparedness:** Preparedness planning is required, as vulnerability can rarely be reduced to zero. Specific measures include contingency planning and preparation of emergency measures against system and network failures induced by climate events.
4. **Financial Protection:** Financial protection is required in the course of assessing and reducing the contingent liabilities of public infrastructure as well as understanding various ex ante and ex post financing instruments meant to ensure that resources are available during the immediate response, recovery, and reconstruction phases.
5. **Resilient Reconstruction:** Resilient reconstruction is part of a comprehensive disaster risk management framework whereby damaged assets and infrastructure are rebuilt so as to reduce or prevent the vulnerability that led to the initial damage or failure. Such activities may include (i) relocating infrastructure; (ii) establishing redundancies and/or interconnections of the system to better ensure continued service delivery post-disaster; and (iii) installing systems and works to protect WSS infrastructure, assets, and services from initial hazards, for example, with drainage improvements, slope stabilization, reforestation, soil improvement, and early warning schemes.

Box 1. Methodology and limitations

The methodology applied is not intended to establish an assessment model, but rather to provide a snapshot of the challenges faced and progress made by countries in the incorporation of DRM and CCA in WSS sector policy framework and practices.

Each of the strategic areas presented in the framework was evaluated through a series of questions. The questions used were tailored to the WSS sector on the basis of the "Guide to Assess Risk Management and Climate Change Adaptation in Sectors" (World Bank 2012) and validated by the RTG-DRM.

The evaluation of the elements is qualitative. The analysis uses a traffic-light color code to facilitate the visualization of results. Each element is scored from 0 to 3 depending on the progress reported towards mainstreaming DRM and CCA considerations, based on the responses to the questions applied. The responses are supported by sources of verification validated thorough document review, country visits for data collection, and consultation with experts from national institutions and regional bodies. The assessments were validated through national and regional workshops by national institutions and FOCARD-APS.



6. Key Findings from the Assessment

The key findings from the assessment are presented below along the proposed analytical framework, summarizing the results of the country-specific assessments included in annex 2.

INSTITUTIONAL, POLICY, REGULATORY, AND FINANCIAL FRAMEWORKS

Highlights

- *The WSS sector is inadequately represented in the DRM and CCA institutional, policy, and regulatory frameworks at both the regional and the national levels.* At the regional level, FOCARD-APS is not directly involved in the development of the main ongoing regional initiatives for DRM and CCA. At the national level, WSS institutions participating in disaster risk management systems are not always the most appropriate or represent only a portion of the WSS sector.
- *Chronic financial shortfalls in the sector hinder mainstreaming DRM and CCA in WSS investments and practices.* The lack of sufficient budget allocations to meet sector investment and rehabilitation needs leads countries to defer the implementation of DRM and CCA measures.
- *DRM and CCA considerations are not commonly considered in pre-investment norms, construction codes, and standards for WSS infrastructure.* Resilient construction and reconstruction practices, which are key to vulnerability avoidance, are not implemented in any of the FOCARD-APS countries. Structural measures refer to resilient construction techniques and materials, while nonstructural measures refer to water resource management, basin protection measures, construction norms and material standards, education strategies and other activities not related with the engineering design and construction of the elements or systems.

The multidisciplinary nature of disaster risk management involves the participation of a multitude of actors across sectors, including national authorities (public works and services, planning and land use, health, education, and finance ministries, among others), nongovernmental organizations, the private sector, and academia. Owing to the close relationship between WSS services and climate variability, WSS sector institutions and service providers are key players in planning and implementing DRM and CCA strategies. It is essential, therefore, to understand how the WSS sector incorporates these considerations into policy and practice.

Table 4. Policy and Regulatory Instruments

POLICY AND REGULATORY INSTRUMENTS (ELEMENTS OF ANALYSIS)	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua	Panama	Dominican Republic

POLICY AND REGULATORY INSTRUMENTS (ELEMENTS OF ANALYSIS)	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua	Panama	Dominican Republic
Do the disaster risk management and climate change legal frameworks consider the WSS sector?							
What institution represents the WSS sector in national disaster risk management forums?	AyA	ANDA	MSPAS INFOM	SANAA CONASA	ENACAL INAA	IDAAN	INAPA
Does the WSS legal framework take into account disaster risk management and climate change adaptation considerations?							
Are disaster risk management and climate change adaptation considered during planning processes in the WSS sector?							
Do national or sectoral planning instruments or the national public investment system norms take DRM and CCA into account in the planning, design, and construction of WSS services?							
Are WSS infrastructure and services explicitly identified as critical, essential, or vital services for disaster risk management?							
Legend	No data reported	No evidence of progress found Score < 1	Moderate progress 1 > Score < 2	Good progress Score > 2			

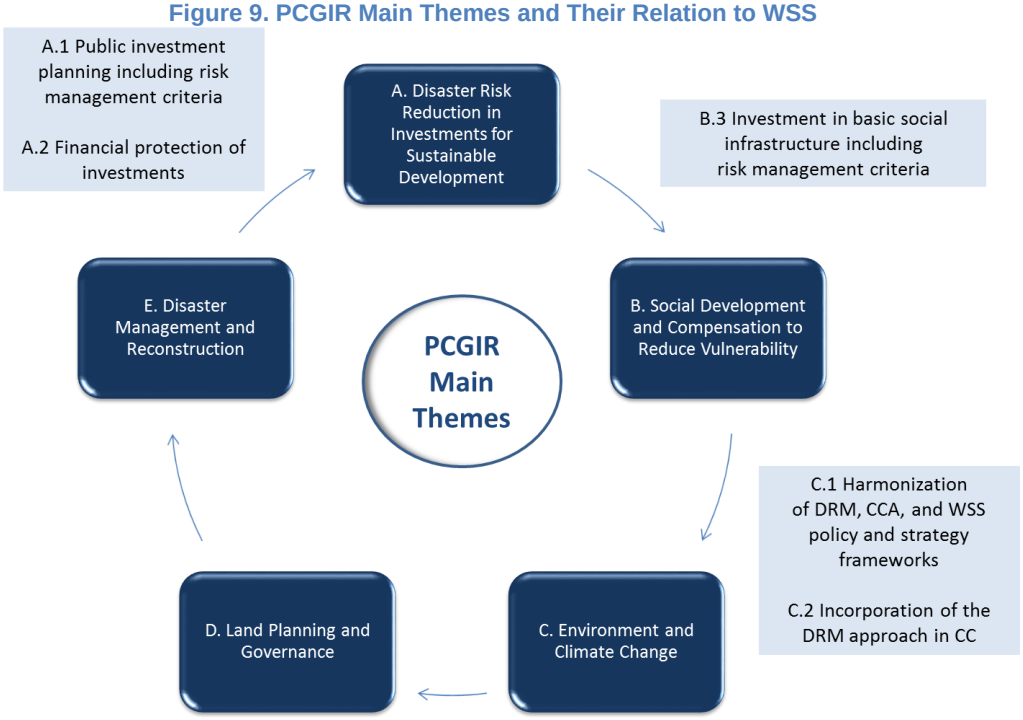
The DRM and CCA Institutional, Policy, and Regulatory Landscape

SICA has a number of regional institutions and platforms in place that facilitate cooperation and integration among member countries regarding drinking water and sanitation services, DRM, CCA and integrated water resources management, namely the FOCARD-APS, the Center for Coordination of Prevention of Natural Disasters (CEPREDENAC), the Commission for Environment and Development (CCAD), and the Regional Committee on Hydraulic Resources (CRRH).

SICA has also developed several regional initiatives that bring together the DRM, CCA, and WSS agendas under the Environmental Subsystem integrated by CEPREDENAC, CCDA, and CRRH. These environmental authorities have adopted a formal Water Agenda and have developed a number of regional strategies and policies, such as (i) the Central America Policy for Comprehensive Disaster Risk Management (PCGIR, 2010), which is one of five key pillars in SICA's prioritized agenda and the most relevant regional public policy instrument in the field; (ii) the Regional Strategy for Climate Change (ERCC), which sets the specific objective of reducing the vulnerability of water resources and related infrastructure to climate change and climate variability; and (iii) the Central America Strategy for Integrated Water Resources Management (ECAGIRH), to address these challenges at the regional level with a broad range of instruments including the Central American Water Covenant (CONVERGIRH) and the Central American Integrated Water Resources Management Plan (PACAGIRH). However, due primarily to its relatively recent establishment and its link to the Health and the Social Subsystem, FOCARD-APS is not included among the regional entities composing this Environmental Subsystem. As a consequence, the WSS sector has not been able to take full advantage of these regional

instruments. For example, the PCGIR explicitly calls for a set of actions concerning the WSS sector in three of its five themes, as presented in figure 9.

Figure 9. PCGIR Main Themes and Their Relation to WSS



Source: Prepared by authors.

The National Systems of Disaster Risk Management (SNGR, by its Spanish acronym) maintain their legal and institutional frameworks. One leading institution is identified, and different responsibilities are assigned based upon institutional and sectoral representation. The WSS institutions representing the sector in the SNGRs are not always the most representative of the entire sector. In most cases, the country's largest WSS service provider is represented, as with AyA in Costa Rica and to a lesser degree, INAPA in the Dominican Republic and SANAA in Honduras; these are major service providers, but serve only a portion of the national population.

It is also worth emphasizing that although in all FOCARD-APS members at least one WSS institution participates in the national DRM platform, none participate on a permanent basis and only Guatemala, Nicaragua and the Dominican Republic explicitly mention WSS institutions in their DRM frameworks (see annex 1 for more complete information).

The WSS Institutional and Regulatory Landscape

Throughout Central America and the Dominican Republic, the lack of a strong policy and regulatory framework for the WSS sector[53] often results in limited inclusion of disaster risk

[53] Throughout the region, a relatively weak policy and regulatory framework also affects aspects related to tariff setting to ensure cost recovery for operations and maintenance, further adding to the physical and financial vulnerability of WSS infrastructure and service provision. As decisions on tariffs are often made by other national institutions (e.g., the Ministry of Finance, the Ministry of Economy) or by local governments—without taking into account the costs of operations, maintenance, and future investment—many utilities are insolvent and often unable to

management and climate change considerations as well as ill-defined roles and responsibilities among the institutional actors involved. A number of actors play a key role in the direction, regulation, and delivery of WSS in rural and urban areas. Annex 1 provides an overview of the relevant country institutions. In general, the WSS sector in FOCARD-APS countries usually consists of a governing body responsible for defining sector policies and programs (a lead agency), and an authority responsible for generating the regulatory framework, approving tariffs, and enforcing standards (a regulator). Urban and rural service providers operate WSS systems and infrastructure, and take charge of development and operations and maintenance (O&M) activities. This multiplicity of sector actors complicates the definition and establishment of functions, responsibilities, and attributions for prevention, preparedness, mitigation, and emergency response.

The legal frameworks and policy instruments for DRM and CCA of FOCARD-APS members enable WSS sector institutions to incorporate relevant aspects of risk management and adaptation to climate change in very different manners. In most cases, these instruments are not developed by sector institutions but consist of cross-sector and inter-institutional higher regulations that the sector must integrate. In the case of Costa Rica, Honduras, and Nicaragua, their legal frameworks help provide more favorable conditions to promote DRM and CCA initiatives. The soundness and continuous updating of the regulatory framework in Costa Rica has allowed the country to achieve major advances in the integration of different aspects of disaster risk management and climate change in the sector, while in Honduras, Nicaragua, and Panama, where a predominantly reactive approach to risk disaster persists, the main WSS service providers have plans for emergency response. In El Salvador, Guatemala, and the Dominican Republic, no evidence was found of legal and policy instruments in the sector that include DRM considerations.

In most FOCARD-APS member countries, the majority of initiatives, achievements, and lessons learned on the theme of DRM and CCA for the WSS sector have largely emerged through the initiative of individual professionals and specific WSS institutions, with the benefits almost exclusively accruing to the individual or institution, with little opportunity to expand the knowledge and learning to other WSS partners.

At the same time, national professional societies and municipal associations have shown themselves to be useful partners in developing national DRM capabilities and even springing into action, oftentimes on a voluntary basis, during times of disaster response. Examples include: RASNIC member support to evaluate water sector damages after Hurricane Felix in 2007; a wastewater treatment vulnerability study implemented at the initiative of Costa Rica's Federated Confraternity of Engineers (CFIA); RASHON's training and roundtable series on DRM and CCA in water and sanitation service delivery; and Nicaragua Association of Municipalities' (AMUNIC) preparation of an Integrated Water and Sanitation Strategic Plan for its members that includes actions in DRM and CCA.

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invest proactively in vulnerability reduction as well as maintain the financial instruments needed to protect their infrastructure and assets.

At the regional level, FOCARD-APS has set DRM and vulnerability reduction as a priority. Although a Regional Thematic Group for DRM (RTG-DRM) was established within FOCARD in 2010, this group has not yet reached any major regional achievement.

The Financial Context

The direct relationship between the effects of climate change, climate-related disasters, and the WSS sector make it necessary for WSS institutions to assume a proactive approach to both adapting existing infrastructure and designing new resilient infrastructure to achieve an effective reduction of vulnerability and to ensure technical, environmental, and financial sustainability.

Box 2. The impact of the 2001 earthquakes in the WSS systems in El Salvador

On January 13 and on February 13 and 17, 2001, the country of El Salvador was hit by three earthquakes of magnitudes 7.6, 6.6, and 5.1 respectively, causing 1,259 deaths and damaging about 186,000 homes.

These events also damaged at least 188 WSS systems, resulting in direct economic losses of more than US$11 million for their rehabilitation and indirect losses of up to US$23.1 million.

During the emergency 98,700 cubic meters of water worth US$400,000 were distributed by tankers,[54] which equates to an investment of US$4.50 per cubic meter just for water transport, according to the National Administration of Aqueducts and Sewers (ANDA).

Investments may be in vain if CCA and DRM measures are not adopted, given that WSS infrastructure is particularly vulnerable to the impacts of climate change and natural disasters. Failures in WSS infrastructure and services generate important social, environmental, and economic impacts.

Resilient infrastructure is required to achieve an effective reduction of vulnerability and ensure sustainable service provision. However, the lack of sufficient budget allocations to meet sector investment and rehabilitation needs leads countries to defer the implementation of DRM and CCA measures.

Box 3. Costa Rica—Estimating historic damage and economic losses in the WSS sector

In 2010, the Public Investment Unit within the Ministry of National Planning and Economic Policy (MIDEPLAN) of Costa Rica, presented "The Economic Impact of Natural and Anthropogenic Extreme Events in Costa Rica, 1988–2009," which represents a first effort to systematize information in the country regarding the direct economic impact of disasters.

On the basis of the information available from national and international institutions, major events that affected the country between 1988 and 2009 were identified, and damages in various productive sectors and infrastructure were estimated.

Urban and rural WSS system damages related to the events occurring between 1991 and 2009 were estimated at US$45 million, not including the indirect costs that service providers incurred for disaster response and rehabilitation efforts.

[54] ANDA (2001). "Emergency Response to 2001 earthquakes."

Public Investment Planning and Project Cycle

Although DRM and CCA considerations are not present in most of the regulatory and institutional frameworks of the WSS sector, this lack has not prevented institutions from planning and implementing concrete DRM actions. The analysis reveals that all FOCARD-APS countries except for El Salvador and the Dominican Republic have sectoral or institutional plans that include DRM-related actions. In fact, in most cases these actions go beyond the preparedness and response requirements that currently prevail in the legal frameworks in the sector.

It must be noted that the more fully consolidated WSS legal and institutional frameworks favor the incorporation of DRM and CCA in WSS services, particularly in sector planning instruments, although in the majority of the countries these are institutional tools (corresponding to the main national service providers) and do not consider rural areas, therefore lacking an integrated sector approach.

Table 5. Design Standards and Operation Protocols

DESIGN STANDARDS AND OPERATION PROTOCOLS (ELEMENTS OF ANALYSIS)	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua	Panama	Dominican Republic
Do design and construction standards and operation protocols for WSS infrastructure incorporate DRM and CCA aspects?							
Risk identification							
Risk reduction							
Preparedness							
Financial protection							
Resilient reconstruction							
Are monitoring and control mechanisms in place to ensure compliance with standards?	ARESEP		INFOM	ERSAP	INAA	ASEP	
Legend	No data reported	No evidence of progress found Score < 1	Moderate progress 1 > Score < 2		Good progress Score > 2		

Since the 1990s many countries in the region have fortified their national public investment systems by including viability and cost – benefit assessments; however, efforts to develop guidelines for incorporating disaster risk analysis in such systems have been limited. Traditionally, the pre-investment phase (ex ante project evaluation phase) does not take risk into consideration as part of the cost-benefit assessment, so risk becomes a hidden cost. Effective economic and financial analysis must bring these hidden costs to light.

Regarding technical aspects, DRM and CCA are taken into account in the design and construction codes and standards only in Costa Rica, Honduras, Nicaragua, and Panama, while

Box 4. Guidelines for risk reduction promoted by regulators—the cases of Nicaragua and Honduras

in El Salvador and the Dominican Republic, they are not considered at all.

In recent years, the Nicaragua WSS regulator—the National Institute for Water and Sanitation (INAA)—has developed several technical instruments to assist WSS service providers in reducing disaster vulnerability, including "Guidelines for Vulnerability Reduction in WSS Systems – Conceptual Framework and Tools," produced with the support of the Swiss Agency for Cooperation and Development (SDC).

The regulating body in Honduras (ERSAPS), supported by PAHO/WHO, developed "Technical Guidance and Protocols for Risk Reduction in WSS Service Management," which considers risk reduction criteria throughout the full project cycle.

These technical tools have not as yet been effective in inspiring the widespread application of DRM and CCA principles in the design, construction, and operation of WSS systems, but they constitute a necessary component. In the architecture of more comprehensive approach to the issue.

RISK IDENTIFICATION

Highlights

- *The limited sector-specific risk information constrains relevant risk analysis for decision making.* Basic information regarding the location and characterization of the main WSS system components, effective monitoring of hydrometeorological variables, and coordinated climate and risk information-gathering systems are essential to adequately conduct detailed hazard and vulnerability analysis. However, only a few utilities in the region keep updated cadastral maps and registries of infrastructure, or climate and hydrometeorological information is often not available or not taken into account by WSS institutions.
- *Knowledge on WSS systems and service interruptions caused by emergencies and disaster situations is almost nonexistent*. Analysis of the impacts of disasters on WSS system functionality and service form the basis of an actionable risk evaluation, though are very limited and have only been conducted on an exceptional basis in a few utilities in Costa Rica and the Dominican Republic.

Weather, water, and climate information and services are needed to make informed and timely decisions to minimize losses. The meteorological station networks are scattered unevenly, with some prioritized regions not served or lack key parameters needed to assess climate-related risks. Precipitation is one of the most studied variables and has the largest number of monitoring stations, though additional data, coupled with long-term historic station data series, would support detailed climate variability analysis. Additionally, it is important to expand and upgrade monitoring of temperature, humidity, wind, evapotranspiration, and radiation. Effective monitoring of hydrometeorological variables, and coordinated climate and risk information-gathering systems are essential to adequately conduct detailed hazard assessments.

Hazard assessments take into account the frequency, intensity, and magnitude of a given event, coupled with the identification and characterization of the vulnerabilities of infrastructure, services, communities, and other exposed system elements of the systems to calculate

Economic, social and environmental impacts.. Risk not only involves how the events affect the systems but also assessing how damages in the WSS systems can potentially affect their surrounding area, such as through the flooding of an area as a result of a broken pipe or a landslide caused by water leakage into the soil. In the WSS sector, risk identification enables stakeholders, namely urban and rural WSS service providers, to incorporate measures into service planning and operation to reduce and prevent risks, and to adequately prepare themselves to respond to potential emergencies. Only by identifying and quantifying risks can appropriate risk management and reduction measures be taken to build on risk-informed decisions at the governmental, institutional, community, and individual levels.

Table 6. Risk Identification

RISK IDENTIFICATION (Hazard, Exposure, and Vulnerability)	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua	Panama	Dominican Republic
Do WSS institutions have access to reliable and updated information about the risks present in the country?							
Do WSS institutions have cadastral information systems and keep an updated registry of the location and characteristics of the main components of the WSS systems?							
Do WSS institutions have monitoring mechanisms of the systems to identify network and main components failures?							
Have WSS institutions generated information on how events/emergencies have altered system functionality?							
Have studies been carried out on the risk or (functional) vulnerability in the WSS sector?							
Do workforce development plans in the WSS sector include opportunities for training in disaster risk management?							
Legend	No data reported	No evidence of progress found Score < 1	Moderate progress 1 > Score < 2	Good progress Score > 2			

WSS institutions in the region—especially those charged with planning, development, operations, and service delivery—lack cadastral maps as well as characterizations of their respective infrastructure. Only a few of the main WSS utilities keep an updated registry of the location and characteristics of the major components of their systems. In the majority of cases, the knowledge of the infrastructure system is based largely on the experience of employees at WSS service providers. Information on how previous events have hampered system functionality or affected the service barely exists, which hinders the ability to conduct meaningful and accurate risk evaluations. Compounding the problem is the fact that the majority of WSS institutions fail to maintain logs of damages to infrastructure and services during emergency and disaster situations. In addition, relevant information is often lacking on the hazards to which the infrastructure is exposed. Some WSS service providers have conducted damage assessments and impact evaluations on their own or with assistance from international actors, though such evaluations fail to be conducted widely or in a standardized and systematized manner.

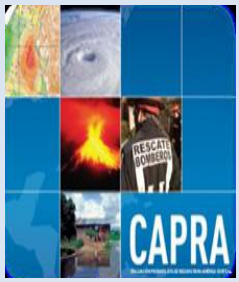
There are only a few specific WSS sector risk evaluations in the in the region, which include (i) probabilistic modeling of risk scenarios for the water and sanitation sector in Costa Rica;[55] (ii) a vulnerability study of the Orosi water system in Costa Rica;[56] and (iii) a vulnerability analysis and mitigation plan for transmission lines in the northeast region of the Dominican Republic,[57] among others.

Despite the generalized lack of access to exposure information of the WSS sector, the country-specific assessments (annex 2) identify some advances in vulnerability studies of the WSS infrastructure in all FOCARD-APS countries. And although in-country capacity exists within technical, scientific, academic, and territorial planning entities for the monitoring of natural phenomena as well as the generation and elaboration of hazard maps and studies, most WSS institutions either do not know of, have access to, and/or make full use of existing information. Many of the studies are conducted by national universities or international development agencies and lack concrete actions for risk reduction or disaster preparedness.

Box 5. Probabilistic modeling of risk scenarios for water and sanitation systems in Costa Rica

AyA used the CAPRA platform, a multi-variable probabilistic analysis tool for risk assessment, to model the annual total expected losses and the probable maximum loss, as well as geographic information system (GIS) maps of the affected areas and infrastructure for different types of hazards (earthquake logs, for example), according to the vulnerability of the exposed infrastructure.

The CAPRA platform has been implemented by AyA in three WSS systems (Metropolitan, San Isidro del General, and San Miguel de Desamparados), where the different system components (pipelines, storage or treatment structures, bridges) are tested for seismic hazard.



AyA developed a risk reduction plan based on these results, according to which specific actions are planned to reduce the risk or conduct more in-depth analysis of the components identified as most vulnerable.

[55] AyA (2012) "*Modelación Probabilística de Escenarios de Riesgo para el Sistema de Agua y Alcantarillado en Costa Rica*."

[56] Arturo Rodriguez (2001) "*Estudio de Vulnerabilidad del Acueducto de Orosi*."

[57] In 2008, the Programme for Disaster Prevention and Preparedness (PPD) supported INAPA in developing a study of the vulnerability of the drinking water and sanitation systems in the northeast region, which are highly exposed to hydrometereological and seismic phenomena. The study identifies actions to be implemented in each component in order to increase their disaster resilience. Further information may be found in the "*Plan de Mitigación de Acueductos en las cinco provincias que componen la región nordeste de la República Dominicana*" (INAPA, UNDP, ECHO 2011).

RISK REDUCTION

Highlights

- *Risk reduction is not highly prioritized in WSS sector policy frameworks and practices in FOCARD-APS countries.* This is in part due to a general misunderstanding and underestimating of the possible effects on WSS infrastructure.
- *The WSS sector lacks the human and financial resources needed for risk reduction.* Only in three countries do primary WSS service providers have dedicated DRM units.
- *Risk reduction has been piecemeal, but select lessons learned and examples of best practice have emerged*. Examples such as the wastewater treatment plant relocation decision in Managua, Nicaragua (see Box 6), and the corrective measures adopted in the Orosi aqueduct in Costa Rica[58] are noteworthy experiences in risk reduction that could be replicated in other countries in the region.

Prospective risk management, which seeks to avoid the development of new or increased risks, is considered the most efficient way to reduce risk. Risk reduction can be achieved in a forward-looking manner through proper planning for the safe location and construction of new infrastructure, and through the use of safety standards and regulations for WSS system design and operation, among other measures. Corrective actions must also be implemented on the basis of an assessment of exposure to different threats and the characterization of the vulnerability for each of the elements of the WSS systems. It is important to prioritize actions to mitigate the greatest impacts on the functionality, quality, and continuity of services in order to minimize the associated social, economic, and environmental impacts.

Table 7. Risk Reduction

RISK REDUCTION (ELEMENTS OF ANALYSIS)	**Costa Rica**	**El Salvador**	**Guatemala**	**Honduras**	**Nicaragua**	**Panama**	**Dominican Republic**
Does the primary WSS service provider have a DRM unit or department?							
Do the primary WSS service provider's operation and maintenance plans take into account aspects related to emergencies and risk management?							
Has funding been assigned for activities specifically related to DRM?							
Have concrete actions to reduce vulnerability in WSS systems been either planned or undertaken?							
Have threat and risk evaluations been included in the construction of new infrastructure?							
Legend	No data reported	No evidence of progress found Score < 1		Moderate progress 1 > Score < 2		Good progress Score > 2	

[58] In 1993, AyA initiated a project to reduce the vulnerability of the Orosi aqueduct, one of the country's major water supply systems, which had been seriously affected by landslides since its construction in 1987. The total project cost was approximately US$1.5 million, representing less than 3 percent of the value of the aqueduct, estimated at US$53 million, and five times the direct cost of the estimated investments that AyA would have to incur if there were a system failure caused by a disaster. The Orosi rehabilitation approach is considered a best practice in disaster risk reduction in the WSS sector, not only for the country but for the Central America region. See www.disaster-info.net/watermitigation/videos/Orosi.pdf.

The absence of technical and regulatory frameworks and evaluations that consider DRM and CCA as key factors in the design and operation of WSS services makes it difficult for WSS institutions to pursue risk reduction activities.[59]

Legal and regulatory frameworks for disaster risk management in Costa Rica, El Salvador, Honduras, Nicaragua, and the Dominican Republic require WSS institutions to maintain an internal DRM unit, though only institutions in Costa Rica, Honduras, and the Dominican Republic have taken steps to put these units in place, indicating a lack of prioritization for the sector. In addition, the rural WSS subsector lacks the requisite attention and representation in disaster risk reduction initiatives—paradoxically resulting in the most vulnerable and least resilient populations being the least represented. Honduras is the only country with a sectoral entity composed of WSS institutions and other relevant stakeholders to address DRM in the sector. Costa Rica (AyA) has promoted the establishment of such a sectoral entity, though it has not yet succeeded in establishing such an initiative within the Ministry of Health.

The allocation of human, technical and financial resources within the WSS sector for DRM has been irregular but has enabled countries such as Costa Rica, Nicaragua, Panama, and (to a lesser degree) Honduras to implement risk reduction interventions in select WSS systems. Many of the first-hand experiences as well as the tools developed at different levels to facilitate risk reduction represent a valuable opportunity from which to learn how entities in the WSS sector conceptualize, design, operate, and maintain services in areas exposed to natural hazards.

Box 6. The decision to relocate the Managua Wastewater Treatment Plant

Construction was set to begin on a wastewater treatment plant for Managua in November 1998 when Hurricane Mitch struck Central America. The storm raised water levels in Lake Managua and flooded areas that had been slated for use for plant components. The floods raised questions about the viability of building in the area and the height of levees that would be needed to protect infrastructure works.

Designs for the plant were revised on the basis of the new evidence of the water levels in the lake. The levees were built one meter higher than originally planned, and the new designs used different materials. Moreover, the plant was moved to a safer area that is less exposed to the effects of high water levels in the lake.

[59] Importantly, it is also significant that in Costa Rica, El Salvador (rural), Guatemala, Nicaragua (rural), Panama, and the Dominican Republic, the lead agency for WSS services is focused on either health and/or social assistance, which has significant implications for what aspect of WSS services is prioritized. Only in Honduras is a single agency exclusively responsible for WSS infrastructure and service delivery.

PREPAREDNESS

Highlights

- *Preparedness is a high priority among countries, unlike other aspects of DRM*. Countries have traditionally focused on emergency response, and they tend to be better prepared to react to disasters than to gather risk evidence, plan, and implement risk reduction actions.
- *However, no country has mapped the WSS institutions that have sufficient capacity for disaster response.* In many cases, WSS response is provided by institutions outside the WSS sector, no specific WSS emergency coordination mechanisms exist, and disaster response plans and protocols are outdated and/or misaligned with national standards.

Adequate preparedness for disaster and emergency situations is essential, as risks cannot be completely eliminated or reduced. Preparedness through early warning systems saves lives and protects basic livelihoods, and is one of the most cost-effective ways to reduce the impact of disasters. For a system to be fully effective, early warning should lead to specific actions, including capacity building of local organizations in preparing for and responding to an emergency or a disaster.

Table 8. Preparedness

PREPAREDNESS	Costa Rica	El Salvador	Guatemala	Honduras	Nicaragua	Panama	Dominican Republic
Does the WSS sector have emergency/contingency plans linked to national/local emergency plans?							
Have competent institutions been identified for WSS response, including an assessment of their respective strengths and capacities for response?							
Does the country have specific national coordination mechanisms for WSS institutions and actors?							
Are tools and procedures available for Damage Assessment and Needs Analysis (DANA) of WSS systems?							

Legend — No data reported | No evidence of progress found Score < 1 | Moderate progress 1 > Score < 2 | Good progress Score > 2

Preparedness among WSS sectors in Central America and the Dominican Republic has been better developed than have other DRM priorities, as demonstrated by the countries' performance in preparing for and responding to emergencies and disasters. Experiences in preparedness stem from all the disasters they have had to deal with, which have contributed to better institutional plans for disaster and emergency response and national sectoral response plans, as well as the requirement for service providers to have such plans. However, only Guatemala and Honduras have functional coordination mechanisms specific for WSS institutions and actors. No country has mapped or assessed WSS institutions' strengths and capacities for disaster response and, in some cases, the response is provided by institutions

outside the WSS sector. No relevant examples were identified of the use of drills to confirm the roles and responsibilities established in emergency plans or verify availability of resources for emergency response. Lack of awareness contributes to increase risk. Better informed service providers and population would be able to more effectively reduce vulnerability and exposure and improve preparedness.

Box 7. Guatemala, Honduras, and Dominican Republic: members of the global Initiative to enhance the emergency and disaster response capacity and coordination in the WSS sector

Guatemala, Honduras, and the Dominican Republic are part of the "Capacity Building and Coordination of Platforms Coordination at the National and Regional Levels for the Water, Sanitation, and Hygiene Sector in High-Risk Countries Project," which is implemented globally with financial support from ECHO-EU.

As part of this initiative, baseline reports were developed for Honduras and Guatemala with the aim of strengthening the capacity of emergency coordination platforms related to water, sanitation, and hygiene nationwide.

These reports assessed main risks, emergency response preparedness, and capacity in the sector, the effectiveness of coordination (including best practices in the field), knowledge of Global WASH Cluster tools, regional support and funding mechanisms in each country.

Although WSS legal frameworks among FOCARD-APS countries include preparedness for emergencies and disasters—as demonstrated in the existence of emergency, contingency, and/or continuity in service provision plans (at least among major WSS service providers and operators) in Costa Rica, Honduras, and Panama—the assessment did not find updated emergency and contingency plans for major WSS service providers in Nicaragua, El Salvador, and the Dominican Republic.

The plans that are in place tend not to be based on reliable disaster scenarios and risk assessments, thus representing a major challenge for preparedness. In addition, different WSS providers (both urban and rural) have their own emergency plans and protocols, which are often misaligned with the procedures of other entities and/or a national standard. WSS providers seldom implement simulations and drills.

Box 8. Preparedness measures for disaster emergency response at Aguas de San Pedro Sula, Honduras

Honduras is one of the three Central American countries that have structures in place to coordinate interinstitutional actions for disaster emergency response in WSS.

Aguas de San Pedro Sula, an Italian-Honduran consortium that was awarded a 30-year concession contract to operate the water and sanitation system in the city of San Pedro Sula, has implemented several emergency response planning measures included as part of the concession contract:

Emergency Response Service. Since the beginning of the provision of services, Aguas de San Pedro has been required to provide 24-hour emergency response mechanisms for their customers.

Water and Sanitation Service Contingency Plans. Aguas de San Pedro was required to prepare a contingency plan for drinking water and sanitation services within the first six months of the contract. These plans included existing and future procedures for emergency prevention related to drinking water and sanitation, as well as an action plan for emergencies, all of which are updated regularly.

Disaster risk management and climate change adaptation in the WSS sector inherently entails multidisciplinary actions involving a number of institutional actors and ministries responsible for civil works and public services, planning and territorial zoning, health, education, and finance, among others. Such efforts further require the active participation of national disaster risk management systems, nongovernmental organizations, the private sector, scientific institutions (e.g., hydrologic, meteorologic, seismologic), and academia (e.g., universities, professional associations, research centers).

Interinstitutional coordination exists to a limited degree on water and DRM in some countries and themes, namely in preparedness and emergency response activities in Honduras and the Dominican Republic. However, despite the clear need for multisectoral approaches to DRM and CCA, FOCARD-APS countries lack national platforms that regularly meet with WSS institutions to assist in the planning, sharing, and advancement of DRM and CCA in the sector. On the basis of an institutional mapping carried out under the assessment, no national-level WSS initiative was identified in Guatemala, Honduras, or Nicaragua for responding to disaster situations in a coordinated and collaborative manner. DRM structures meant to coordinate interinstitutional actions during disaster and emergency response phases were identified in the Dominican Republic, Guatemala, and Honduras. Largely managed within each country's national system of disaster risk management, these structures include WSS "representatives" but do not ensure that the full range of WSS institutions are represented. In the remaining countries, cross-sectoral or interinstitutional coordination is largely ad hoc and mobilized only in times of emergencies or disasters.

FINANCIAL PROTECTION

Highlights

- *The lack of risk information prevents the development and utilization of financial instruments tailored to the WSS sector.*
- *Clear examples of financial protection and insurance remain to be developed in the WSS sector in Central America and the Dominican Republic.*

Financial protection strategies relieve governments, utilities, and households of the economic burden of disasters by increasing the financial capacity to respond to an emergency. Applied to the WSS sector, disaster risk financing and insurance offers service providers the short-term liquidity needed to implement contingency actions, works, and acquisitions as well as to return damaged infrastructure to pre-existing conditions, while minimizing total costs for the utility.

In both Costa Rica[60] and Honduras,[61] financial protection and risk transfer are mentioned in the WSS regulatory frameworks. Panama has recently approved a strategy for disaster risk financing and insurance. However, none of the countries studied offer clear examples in which WSS infrastructure is insured. Costa Rica[62] and Guatemala[63] include financial protection and risk transfer in their national disaster risk management plans. However, the only items insured have been in isolated cases and have included offices, vehicles, workers, damages to third parties, and/or specific components.

Sound risk financing strategies for the WSS sector are essential as they offer the benefit of protecting a government from future contingent liabilities should a disaster strike and can help providers resume service more quickly after a disaster. Utilizing financial protection instruments such as catastrophe bonds and catastrophe risk insurance can be useful, particularly to protect against high-impact, low-frequency events such as earthquakes and hurricanes. Such strategies therefore reduce a country's fiscal vulnerability to disaster as well as its potential reliance on international assistance. Such strategies further incentivize a country to adopt sound mitigation measures and deepen local knowledge on the subject.[64] El Salvador, Costa Rica and Panama all have World Bank Development Policy Loans (DPL) with Catastrophe Deferred Drawdown Option (CAT DDO).[65] This flexible tool for middle-income countries requires countries to develop and maintain a disaster risk management program in exchange for immediate access to emergency funding in case of disasters. Honduras and Nicaragua utilize the Immediate Response Mechanism (IRM),[66] an instrument included in International Development Association (IDA) projects which allows borrowing countries to rapidly access up to 5 percent of their undisbursed IDA investment project balances following an emergency. Table 9 outlines the financial protection mechanisms currently in place in the subregion.

[60] Article 19, 31 – Law Number 7593 of the Regulatory Authority of Public Services and its Reforms.
[61] Article 24 – Decree 283-98 – Law of the Promotion and Development of Public Works in the National Infrastructure.
[62] National Disaster Risk Management Plan 2010–2015 – Costa Rica.
[63] National Policy for Disaster Risk Reduction – Guatemala.
[64] Resilient Infrastructure for Sustainable Services. Latin America: Mainstreaming of Disaster Risk Management in the Water Supply and Sanitation Sector. (Water and Sanitation Program: May 2012).
[65] Development Policy Loan (DPL) with Catastrophe Deferred Drawdown Option (CAT DDO) provide immediate liquidity of up to US$500 million or 0.25 percent of GDP (whichever is less) to IBRD-member countries in the event of a disaster caused by natural phenomena.
[66] Introduced in December 2011, the Immediate Response Mechanism (IRM) complements longer-term emergency response tools available to IDA countries (e.g. Crisis Response Window), offering them financial support within weeks rather than months after an emergency. IRMs often exist as a Contingent Component with zero dollars allocated and stand ready to receive a rapid reallocation of funds – without requiring prior project restructuring. Currently, five IDA projects in Honduras (Disaster Risk Management Project, Safer Municipalities Project, Social Protection Project, Second Road Rehabilitation and Improvement Project, and Water and Sanitation Project) and three IDA projects in Nicaragua (Second Land Administration Project, Fifth Roads Rehabilitation and Maintenance Project, Second Rural Water Supply and Sanitation Project) include Contingent Components.

Table 9. Fiscal Protection Instruments against Disasters, by Country

	Fiscal Protection Strategy	Contingent Budget and National Disaster Funds	World Bank Contingent Lines	IDB Contingent Credit	Catastrophic Risk Pooling
Costa Rica	Implicit	Yes	CAT -DDO	No	No
El Salvador	No	No	CAT –DDO (closed)	Yes	No
Guatemala	No	No	CAT –DDO (closed)	No	No
Honduras	No	No	IRM	Yes	No
Nicaragua	No	No	IRM	Yes	Yes
Panama	Explicit	Yes	CAT -DDO	Yes	No
Dominican Republic	No	No	No	Yes	No

Source: Prepared by authors.

The WSS sector in Central America and the Dominican Republic, in line with much of Latin America, has little experience in designing and implementing risk retention and transfer strategies. One of the principal limitations to insuring WSS infrastructure and services has been the lack of cadastral information on the infrastructure and assets on the part of WSS service providers. Such limited knowledge has significant financial implications because of the inability to cost out potential premium payments or tariff variations. A potential regional example of best practice includes the case of Chile after the 2010 earthquake, where financial protection mechanisms for infrastructure helped the utility quickly access credit to respond effectively. However, several steps precede the design of risk financing and insurance for vulnerable assets and infrastructure, including the quantification of risk arising from natural hazards,[67] which in turn relies on high-resolution datasets (using geospatial information on assets and infrastructure) as well as concerted interinstitutional efforts to estimate potential damages and losses from expected disaster and climate change impacts.

The 8.8 magnitude earthquake occurred off the coast of central Chile on February 27, 2010.[68] The earthquake triggered a tsunami that devastated several coastal towns along 630 kilometers in the south-central region of the country, affecting the entire service area of Essbio SA, a water company serving more than 630,000 customers in 89 towns in southern Chile.

At the time of the earthquake, Essbio assets were valued at US$600 million and damages to the urban WSS sector were estimated at over US$100 million in the regions of Biobio and Maule alone.

After a thorough damage assessment and negotiations between Essbio and the insurance company, the latter paid the total insured amount of US$130 million. Maintaining earthquake insurance for the infrastructure made possible rapid replacement of the damaged sites.

Box 9. The benefits of being insured: The case of Chile after the 2010 earthquake

[67] In Honduras, it is recommended that efforts begin to value the risk and cost of WSS infrastructure exposed to risk, with the intention of designing and scaling up financial protection instruments, while in Costa Rica, it is recommended that efforts begin to quantify the investments and benefits of insurance for AyA and other WSS service providers, by applying a regulatory framework and the tariffs of ARESEP.

RESILIENT RECONSTRUCTION

Highlights

- *Temporary reconstruction solutions to tackle urgent situations in the aftermath of an event have often become long-term unsustainable results.* This is caused by the lack of a long-term vision coupled with limited resources allocated to response processes, which hinders the resilient reconstruction of WSS infrastructure.

Temporary, rehabilitative solutions meant to address an emergency situation have often become the default long-term reconstruction approach—often resulting in greater risk exposure and greater vulnerability of WSS infrastructure. This cycle is often a result of authorities' perception that an initial problem has been solved once WSS services are restored. This misconception, however, makes it difficult to dedicate the resources needed to truly rebuild in a resilient way that reduces risk going forward. Moreover, these difficulties are greater for small and rural WSS service providers that lack the connections with higher-level decision makers needed to secure the financial resources necessary for resilient and sustainable reconstruction.

Long-standing consensus suggests that reconstruction should take resilience into account in order to avoid simply rebuilding with the same vulnerability that led to the initial failure. Nevertheless, few countries have incorporated resilient reconstruction in their legal frameworks or the required actions in their national systems of disaster risk management. The exception is the legal framework of the Dominican Republic, which integrated such stipulations in 2002. The assessment was unable to identify specific experiences or best practices of resilient reconstruction among the WSS services in Central America and the Dominican Republic.

Box 10. Incorporating DRM into the WSS infrastructure pre-investment phase: first steps in Honduras and Colombia

In recent years, some countries in the Latin America region have worked to develop methodologies for incorporating DRM into the WSS project cycle for public infrastructure investments.

This is the case in Colombia, where the Water and Sanitation Regulatory Commission (CRA) is working on updating the methodology for calculating public water utility tariffs. Moving forward, during the investment planning phase, all investment projects will include a special component on risk analysis with the aim of guaranteeing project resiliency and improving sustainability.

The government of Honduras has also prepared guidelines for incorporating mitigation measures in WSS projects. The National Risk Management System (SINAGER) Law sets forth that DRM is a national policy of a permanent nature and calls for the incorporation of a DRM component into land use planning programs and strategies. The guidelines being prepared are based on the assumption of including DRM processes in projects' technical analysis.

[68] Jose Luis Arraño, Engineering Director, ESSBIO, Chile. "*El terremoto invisible — Identificación del daño no visible en las redes de agua potable post terremoto y tsunami del 27 de Febrero de 2010 en Essbio S.A. Chile*," report from the workshop on Disaster Risk Management in WSS Utilities, November 29-30, 2012 (unpublished).

7. Recommendations

For WSS in Central America and the Dominican Republic, the historic tendency has been to address damages following an emergency or disaster event, rather than proactively plan and implement actions and measures to reduce climate and disaster risk. Such actions, however, have not resulted in more resilient service provision. Often, rebuilt infrastructure exhibits the identical vulnerabilities that led to the damages in the first place. To break this cycle, a number of actions can be taken proactively to improve the long-term climate and disaster resilience of the region's WSS sector. It is with this understanding that the following resilience-building recommendations are proposed. Recommendations are organized in accordance with the proposed analytical framework and provided the basis for concrete national and regional actions identified by clients as presented in section 8. General recommendations are provided at the regional level.

Institutional, Policy, and Regulatory Frameworks:

- ***Strengthen policy and regulatory frameworks to enable favorable conditions for mainstreaming DRM and CCA in national and/or sectoral initiatives***. Legal and technical frameworks should be living documents, meant to be updated on the basis of new developments and understanding generated from new analysis and changing realities.
- ***Promote strong interinstitutional coordination that builds on respective strengths.*** Strong coordination among relevant agencies at the nexus of WSS, DRM, and CCA is essential for mainstreaming DRM and CCA measures in the WSS sector.
- ***Build links with other institutions involved in DRM and CCA, including academia, to facilitate information and knowledge flows.*** Collaboration with scientific institutions can help tie research outputs with the operations of service providers. Hydrometeorological information on flow rates as well as reservoir levels are important inputs for risk-informed decision making and planning.
- ***Update and develop new design and construction standards and guidelines to mainstream CCA and DRM for WSS investments at all steps of the project cycle*.** WSS investment planning, design, and operation require a formal risk-based analysis in all aspects of the project cycle. An experience that could be considered a reference is the ongoing process that the Nicaraguan Ministry of Finance is leading, with SDC support, to incorporate CCA and DRM into the country's investment procedures.
- ***Develop an institutionalized approach to assist small towns and rural water service providers in DRM***. Small towns and rural service providers often require stronger support to mitigate potential risks and recover from impacts of disasters.
- ***Leverage international support for knowledge sharing and capacity building***. Donors and international organizations could provide support in developing knowledge management and capacity-building strategies and activities to better promote disaster and climate resilience systematically across the sector at all levels.

- ***Implement workforce development opportunities at WSS sector institutions that include training in disaster risk management.*** Knowledge of DRM concepts and protocols is important to boost awareness of the topic in daily activities.
- ***Systematically define WSS roles and responsibilities in DRM and CCA, and allocate and assign the financial and human resources required to carry these out***.[69] It is important to note that the key node of intervention should always be the WSS service provider because it bears direct responsibility for infrastructure and service delivery, and is accountable to its customers. The Dominican Republic has taken a step forward and it is in the process of formalizing WSS sector roles through the promulgation of a WSS sector law that incorporates DRM. Table 10 suggests roles and responsibilities for key stakeholders in the WSS sector.

Table 10. Roles and Responsibilities for WSS Institutions in DRM and CCA[70]

Institution	Proposed roles
Lead agency, regulator	- Update WSS sector design and construction standards to consider climate adaptation aspects and incorporate lessons learned for emergency and disaster situations. - Provide the framework and instruments for effective climate and hydromet monitoring prioritize the investments needed, such as soil and water conservation. - Maintain a legal and regulatory framework that encourages operators to plan and implement climate and disaster risk retention and risk transfer mechanisms. - Ensure that regulatory frameworks and/or contracts explicitly mention the responsibilities of service providers, the minimum service levels required in emergency situations (e.g., quantity, quality, and continuity), and the magnitude and type of disasters in which the operator is exempt from their responsibility to deliver services. - Review tariff calculations to consider DRM and CCA aspects and enable the implementation of measures based on vulnerability and risk assessment of WSS services. - Assign the resources needed to adequately monitor compliance with standards.
Service providers (public and private; municipalities)	- Assess vulnerability and conduct probabilistic risk studies of existing systems to develop adaptation and risk reduction options. - Diversify sources of water supply through the construction of new storage facilities, the sustainable extraction of groundwater, or water trading, complementing the need to promote watershed conservation. - Consider CCA and DRM criteria for robust decision making, planning, design, construction, and operation of WSS systems to reduce risk and ensure service functionality in a wider range of future (climatic) conditions. - Implement adaptation and risk reduction actions such as, strategies for water use efficiency and water demand reduction, water resource protection, or preventive and corrective maintenance for physical infrastructure. - Maintain plans and protocols harmonized with national DRM and CCA plans and implement drill exercises to improve response capacity for emergencies and disasters.

[69] To this end, it is recommended that Nicaragua, for example, operationalize DRM and CCA actions included in the Water and Sanitation Sector Master Plan 2012–2017 currently being prepared by ENACAL

[70] Adapted from OPS/OMS, EIRD, UNICEF, and FICR (2006) "*El desafío del sector de agua y saneamiento en la reducción de desastres: mejorar la calidad de vida reduciendo vulnerabilidades*," www.unicef.org/lac/DesafioDelAgua_Spa(2).pdf.

Institution	Proposed roles
	- Secure flexible funding to respond adequately to rapid onset climate and disaster shocks. - Maintain risk retention and risk transfer mechanisms to better ensure sufficient resources and expedited procedures are in place during emergency situations. - Incorporate training on key aspects of DRM and CCA in career development for technical and operational personnel.
Universities, associations, professional schools	- Incorporate aspects of DRM and CCA in studies relevant to WSS. - Contribute to updating the WSS sector knowledge base, regulations, and technical instruments, based on analytical work and lessons learned following emergency and disaster situations.
Donors, multilaterals, international development agencies	- Take into account DRM and CCA aspects in the design of WSS programs and projects, so as to better ensure their long-term financial and environmental sustainability (particularly for reconstruction programs and projects of WSS systems affected by disasters). - Support WSS service providers to conduct vulnerability and probabilistic risk assessments and implement adaptation and risk reduction interventions derived from those assessments. - Support interventions that promote community-based participatory planning and enhance communities' physical assets to supporting adaptation to climate change.

Risk Identification:

- ***Maintain current information and generate comprehensive risk information for evidence-based decision making.*** Updated cadastral maps by service providers, shared effective monitoring of hydrometeorological variables, and coordinated climate and risk information-gathering systems will enable hazard assessments, vulnerability and risk analysis to inform decision making. The analysis[71] will be critical to (i) define risk reduction actions; (ii) modify technical criteria for design and/or construction; and (iii) plan preparedness and response measures for service delivery. In Costa Rica, it is suggested that risk analysis be further carried out to complement earlier results obtained from the PIEV and CAPRA analysis of AyA infrastructure, while in El Salvador, WSS services can be incorporated in risk analysis initiatives carried out by the Environmental Observatory of the Ministry of Environment and Natural Resources (MARN). These experiences offer valuable examples for other countries to follow.
- ***Conduct systematic and standardized assessments of infrastructure and services damage induced by disasters.*** With support from national-level entities, WSS institutions and service providers need to build the staff capacity necessary to generate relevant information on how disasters affect WSS services and infrastructure and to

[71] In order to prioritize risk reduction actions from risk analyses, the following issues must be addressed: (i) severity of service interruption; (ii) recurrence of the phenomena that generated the risk; (iii) required costs for rehabilitation in the event that such a hazard event materializes; (iv) required time for the total and partial rehabilitation of the affected component; (v) population affected by the impact of such an interruption; (vi) potential effect on key assets and vital lines; and (vii) possible human losses and effects on the health and well-being of the population.

implement efficient monitoring mechanisms. Understanding the effects generated by previous events could drive very important lessons for corrective measures.

Risk Reduction:

- ***Integrate DRM in daily WSS service operation*.** WSS service providers need to fully incorporate DRM and CCA into their daily operations by adopting O&M plans that include risk management considerations, and by making risk-informed decisions on new sector investments. An illustrating experience, could be the process that Nicaragua is implementing in the development of master plans for drainage in urban areas to reduce risk to WSS services.
- ***Create specific units within service providers for DRM and CCA***, following the examples of AyA in Costa Rica or INAPA in the Dominican Republic. Provide sufficient human and financial resources to implement actions required to reduce the underlying drivers of risk.
- ***Promote integrated water resource management (IWRM) to address the growing challenge of water scarcity.*** Effective IWRM can curb the worst impacts of climate variability on water resources and WSS services, especially along the Dry Corridor. IWRM can help capitalize on solutions to cope with the exacerbated cycle of drought and flood, and competition for increasingly scarce water resources, which result in a broad range of direct and indirect positive outcomes for stakeholders, whether they are households and businesses experiencing fewer days of water outages or farmers with more water to irrigate their crops. In recent years, innovative financing mechanisms – and more specifically payments for ecosystem services (PES) – have become crucial for addressing failures in environmental management. PES make it possible to internalize environmental costs and benefits in decision making. Costa Rica, is a good example of a country seeking to incorporate PES mechanisms to protect freshwater sources and supply basins.
- ***Incorporate preventive and corrective measures in the WSS infrastructure and practices is not always more expensive.*** Risks reduction measures include measures to construct infrastructure in safe places and build or retrofit components to reduce physical vulnerability and exposure conditions, preventive measures to reduce the effects of some hazards (i.e flood protection structures). Nonstructural measures span policy, planning, training and capacity building activities. The avoided costs through preventive and corrective measures can be measured in terms of the reduction in economic, social, and environmental impacts, whether they are triggered directly by the event or occur over time as indirect effects. The relocation of the waste water treatment plant for Managua to a safer area after the would-be site was flooded during hurricane Mitch is a good example of a cost-effective decision for risk reduction. Cost-benefit studies showed that costly levees would be required to prevent flooding in the area.

Preparedness:

- ***Support development of early warning systems and regularly update existing emergency plans and protocols.*** Strategic and operational planning establishes priorities, identifies expected levels of performance and capability requirements, provides the standard for assessing capabilities and helps stakeholders learn their roles.

Plans should be continuously evaluated and improved through a cycle of planning, organizing, training, equipping, exercising, evaluating, and taking corrective action. WSS institutions must harmonize their emergency plans and protocols with national standards, so as to ensure a coordinated and effective response. Experiences that could be replicated include procedures Honduras has put in place for emergencies related to drinking water and sanitation, as well as an action plan for emergencies, all of which are updated regularly. Similarly, Panama is working to expand existing IDAAN work on DRM and contingency plans to better understand existing vulnerability in order to reduce risk as well as necessary response actions in case of an emergency that affects the WSS systems.

- ***Define roles, responsibilities, and response capacity before a disaster strikes.*** Effective plans should tell those with operational responsibilities what to do and why to do it, and they instruct those outside the jurisdiction in how to provide support and what to expect. WSS institutions and service providers must clearly identify their roles and responsibilities and develop business continuity plans as well as interinstitutional and cross-sectoral coordination mechanisms in order to be able to provide these services during emergencies and disasters. Drill exercises could help evaluate the adequacy of established roles and responsibilities as well as readiness for emergency response.
- ***Leverage interest in preparedness as an entry to other DRM and CCA areas.*** Given the high priority placed on disaster preparedness in the WSS entities revealed in this assessment, focusing on this pillar may prove to be a strategic entry point for a broader and more comprehensive discussion on improved interinstitutional coordination toward greater climate and disaster resilience.
- ***Raise public awareness about the risk of disaster and what to do when one strikes through media and schools program***. Awareness campaigns aim for behavioral changes based on new social norms and attitudes towards water use, and preventive measures. Generating understanding among WSS operators and the population in general is critical to generate proactive and informed actions to reduce risk conditions in a collaborative way.

Financial Protection:

- ***Generate robust risk information for designing risk financing and insurance strategies.*** The ability to quantify potential losses from disasters as well as the cost associated with needed interventions for recovery and reconstruction activities can help the sector ascertain its contingent liabilities. Disaster risk financing and insurance mechanisms can prevent sudden economic shocks that negatively impact fiscal performance and a long-term economic development.
- ***Explore potential options for disaster risk finance.*** Insurance and other risk financing instruments should be considered and established as an obligation for service providers in the regulatory framework for the sector, in order to be prepared to replace their damaged facilities after an earthquake or other natural catastrophes. One good example of how earthquake insurance helped a WSS utility, can be found in Southern Chile

where EESBIO quickly replaced its infrastructure following 7.8 magnitude earthquake in 2010 thanks to the quick liquidity provided by its insurance coverage.

Resilient Reconstruction:

- ***Resilient reconstruction should be better integrated into DRM and CCA frameworks,*** in order to prevent the reconstruction of pre-existing vulnerabilities during emergency response efforts. The Honduran government has prepared guidelines to incorporate DRM processes in technical analysis of projects.
- ***Promote redundancy of interconnected public services,*** such as water, energy, and telecommunications. Having alternative options of water and energy supplies in case of a system failure improves response capacity and may be critical for service continuity during an emergency.

Regional Recommendations

Based on the current FOCARD-APS Strategic Plan 2015–2020 and the Regional Technical Group for Disaster Risk Management (GTR-GRD) Action Plan,[72] and in continuation of activities that meet the criteria above and are part of the planning processes conducted by FOCARD-APS members, the following regional opportunities have been identified:

- ***Capitalize on current regional initiatives, to increase the likelihood that proposed DRM and CCA opportunities in the WSS sector will be successful***. It is helpful to link initiatives to the agenda of a SICA regional entity (e.g., FOCARD-APS, CCAD, CEPREDENAC, CRRH) to help gain political traction.
- ***Operationalize existing regional policies that promote DRM and CCA in the WSS sector.*** Advancing on specific actions detailed within strategies such as the Regional Strategy for Climate Change (ERCC),[73] the Environmental Plan of the Central America Region (PARCA),[74] or the Central America Strategy for Integrated Water Resource Management (ECAGIRH),[75] offer opportunities to institutionalize the links at the nexus of DRM and WSS—particularly as a way to set a policy precedent that would make it easier to leverage donor resources toward such activities. SDC is supporting the harmonization of the PCGIR in Central American countries.
- ***Harmonize methodologies, tools, instruments and information across the region***. Compile a regional inventory of existing tools, as well as to pursue efforts to develop common methodologies, instruments, and regional expertise. In addition, hazard information should be collected, mapped, and disseminated at the regional level, underscoring the need for standardized data gathering, management, and analytical

[72] Developed on the basis of FOCARD-APS, CRRH, CCAD, and COSUDE (2012), "Workshop Report: Integrating Disaster Risk Management and Climate Adaptation in the Water and Sanitation Sector," Montelimar, Nicaragua, 12–14 November; FOCARD-APS (2013), "Regional Workshop to Monitor Country Advances in Water and Sanitation," Guatemala, 24-25 April.
[73] Estrategia Regional de Cambio Climático (ERCC).
[74] Plan Ambiental de la Región Centroamericana (PARCA).
[75] Estrategia Centroamericana para la Gestión Integrada de los Recursos Hídricos (ECAGIRH).

tools and methodologies, possibly along the lines of the Comprehensive Climate Risk Management Framework (MEGIRC).[76]

- ***Encourage regional knowledge exchange and capacity building.*** Conduct capacity-building workshops for WSS service providers as well as scientific and academic institutions on probabilistic risk assessment methodologies such as CAPRA and PIEVC. Ensure that dialogue, exchange, and technical cooperation occurs between similar institutions (e.g., lead agency–lead agency; regulator–regulator; service provider–service provider).
- ***Include DRM and CCA in sanitary and environmental engineering university curricula to build local capacity.*** Several institutions in the subregion are developing educational programs in collaboration with international partners. Examples include a longstanding relationship between the Regional School of Sanitary Engineering and Water Resources in Guatemala and universities in the U.S. State of North Carolina, Switzerland, and Germany, and a recent partnership between the Central American Superior Council of Universities and SDC.

8. The Way Forward: Client Priorities and Opportunities for Engagement

There is a clear need to deepen efforts in disaster risk management and climate-resilient development in the water and sanitation sector. An increased focus on DRM in the sector can contribute to saving lives and livelihoods, and supporting poverty reduction by increasing the resilience of communities. It can also help protect economic growth by making water and sanitation services last. Similarly, it is a good place to start when planning for the impacts of climate change. Growing demand from countries and the possibilities afforded by new tools and techniques to better understand and manage risk provide a unique opportunity to support developing countries on their path toward a more sustainable and prosperous future.

The policy dialogue facilitated through this activity helped identify priority areas that client governments and regional bodies have a concrete interest to develop. The FOCARD-APS Strategic Plan 2015–2020 and the RTG-DRM plan of action build on the priorities identified and represent opportunities for engagement at the nexus of WSS with CCA and DRM in Central America and Dominican Republic. Table 11 complements the recommendations outlined above to summarize key initiatives identified by clients and opportunities for engagement at the nexus of DRM, CCA, and WSS in each country and at the regional level.

[76] Marco de Gestión Integral de Riesgos Climáticos (MEGIRC).

Table 11. Client Priorities and Opportunities for Engagement at the nexus of DRM, CCA and WSS in Central America and the Dominican Republic

	Client Priorities for Integration of DRM and CCA in WSS Sector		
	CCA & DRM / WSS Challenges	**Existing Country Programs, Policies, and Plans**	**Priorities Identified by Clients**
Costa Rica	*Key Disaster/Climate Risk Challenge* • Climate change will likely increase frequency and intensity of extreme rains, flooding and drought. • More chronic levels of water scarcity experienced in areas within the Dry Corridor. • Seismic risk along the Pacific Coast. *Key WSS Challenges* • While on track to meeting MDG targets for improved water and sanitation, WSS coverage gaps remain between urban and rural areas. • Urban sanitation (95 percent) and rural water (91 percent) coverage rates currently do not meet the MDG targets. *Key Institutional Challenges* • The WSS sector is not fully represented in the national DRM system as only AyA (Costa Rica's primary urban service provider) is represented.	*Responsible Entities* • National Risk Prevention and Emergency Response Commission *Relevant Plans/Policies* • National Disaster Risk Management Plan 2010-2015	*Risk Identification* • Carry out vulnerability studies on specific components in line with the results obtained from the CAPRA analysis of the AyA infrastructure. • Expand the application of the PIEVC protocol to promote CCA in other WSS systems. *Risk Reduction* • Better include water and sanitation sector within the National Management Group for Disaster Reduction (*Grupo Nacional de Gestión para la Reducción de Desastres* – GTN GRD) as proposed by AyA in 2011 to have a formal space of technical exchange and operational support for enhanced risk management. • Incorporate payment for environmental services to protect freshwater sources and supply basins. *Financial Protection* • Quantify the investments and benefits of insurance for AyA and other WSS service providers, by applying a regulatory framework and ARESEP tariff.
	Opportunities for World Bank Engagement		
	Existing Engagement DRM/Water	**Country Partnership Strategy / Framework**	**Engagement DRM&CCA/Water**
	CPF FY16 - FY20 • *Pillar II Objective 2.3*: Expand capacity to promote climate-smart & environmentally sustainable development	*Water* *DRM* • Costa Rica Catastrophe Deferred Draw Down Option (P111926) • CAPRA TAPs – Seismic risk assessment of WSS infrastructure in San Jose, San Isidro, and Higuito.	*Pipeline Lending (World Bank)* • Caribbean Coastal Sewerage and Flood Control (P152348) *Proposed TA (World Bank)* • TA - IUWM Desamparados Stakeholders Engagement (P150814) *Additional Activities (Other Partners)* • CABEI *-Water Supply Program in San Jose* • *JICA-IDB-BNCR- Environmental Improvement in San Jose Metropolitan Area Project* • *GIZ - partially finances the Rural Water Supply and Basic Sanitation Project II* • AECID/FCAS *- WSS Program and Access to Water Supply in Rural Settlements Program*

Dominican Republic

Client Priorities for Integration of DRM and CCA in WSS Sector

CCA & DRM / WSS Challenges	Existing Country Programs, Policies, and Plans	Priorities Identified by Clients
Key Disaster/Climate Risk Challenge • World's eighth most affected country by extreme weather events from 1994-2013. (Germanwatch) • Entire country highly exposed to hurricanes, with high seismic risk along north and south coasts. • Water Security is a growing concern. *Key WSS Challenges* • Not on track to meet MDG water target and progress insufficient in meeting MDG sanitation target. • Significant setback in urban water coverage (91 percent to 82 percent) has resulted in national reduction in overall improved water coverage rate (86 percent to 82 percent) over the period 2000-2011. *Key Institutional Challenges* • While INAPA (national water and sewerage agency) is represented in SNGR, minimal DRM or CCA considerations exist in the WSS legal framework, planning instruments, construction codes and/or technical standards.	*Responsible Entities* • National Disaster Prevention, Mitigation, and Response System (SN-PMR) *Relevant Plans/Policies* • Law 147-02 – concerning disaster risk management. Regulation 874-09 on disaster risk management (2009) • National Development Strategy • INAPA National Emergency Plan • INAPA Emergency Manual for Disaster Situations (1996- 2014)	*General Risk Management* • Contribute to the implementation of liability actions in the WSS sector included in the National Plan of Comprehensive Management of Risk, through: (a) evaluation of physical vulnerability of vital water lines; (b) appropriate mitigation/technical measures to reduce seismic and tsunami vulnerability of WSS infrastructure and services; (c) regulate the construction of vital infrastructure; contingency measures of public service networks and vital water lines. • Inform the drafting and design of a WSS law, specifically to incorporate risk management in new WSS regulations as well as define the role of each WSS institution.

Opportunities for World Bank Engagement

Country Partnership Strategy / Framework	Existing Engagement DRM/Water	Proposed Activities for Engagement
CPS FY10-FY13 • *Objective 2*: Promote competitiveness in a sustainable and resilient economic environment (WSS in tourist areas, energy, DRM, health)	*Water* • WSS in Tourist Areas (P054221) *DRM* • No current or pipeline operations	*Pipeline Lending or TA (World Bank)* • Technical Assistance Project (TAP) to strengthen resilience of Urban WSS utilities by developing a seismic risk assessment of WSS infrastructure under the CAPRA Program (P144982) *Additional Activities (Other Partners)* • GIZ - Climate Change • IDB - Santiago WSS Service Improvement Program, INAPA WSS Investment Program and the Disaster Prevention and Risk Management Program • AECID/FCAS - Rural WSS Project, Support to the National Strategy for Sanitation, Expansion of the Aqueduct Oriental, Water Supply Service Quality Improvement in Local Communities of Monte Plata Province Project

El Salvador

Client Priorities for Integration of DRM and CCA in WSS Sector		
CCA & DRM / WSS Challenges	**Existing Country Programs, Policies, and Plans**	**Priorities Identified by Clients**
Key Disaster/Climate Risk Challenge • World's twelfth most affected country to extreme weather events from 1994-2013. (Germanwatch) • The entire country lies within the Dry Corridor making it highly vulnerable to drought and water shortages. • Seismic risk throughout the country. • Estimated direct losses as a result of natural phenomena equivalent to 8 percent of total public and private investments. (UNISDR) • Water Scarcity *Key WSS Challenges* • MDG target for improved water supply has been met and progress remains on track in meeting MDG target for sanitation. • Significant gaps in access to improved water supply (94 percent vs. 81 percent) and sanitation (79 percent vs 53 percent) between urban and rural areas. • Very low coverage rate in improved rural sanitation. *Key Institutional Challenges* • No formal representation of the WSS sector in the SNGR; participation is ad hoc and largely determined by the relevance and magnitude of the emergency or disaster.	*Responsible Entities* • National Civil Protection and Disaster Risk Prevention and Mitigation System *Relevant Plans/Policies* • Civil Protection, Prevention, and Disaster Mitigation Law • Institutional Plan for Emergency and Disaster Response (2004) • Basic Guidelines for Regional Offices to Develop Plans for Emergency and Disaster Response (2003)	*Risk Identification* • Include WSS services in risk analysis initiatives (i.e. CAPRA or similar) carried out by the Environmental Observatory of MARN. *Risk Reduction* • Considering the fragility of the country's hydraulic resources, the WSS sector should incorporate measures based on recommendations provided by programs and studies on the climate change adaptation of the WSS sector.
Opportunities for World Bank Engagement		
Country Partnership Strategy / Framework	**Existing Engagement DRM/Water**	**Proposed Activities for Engagement**
CPF FY16-FY19 • *Pillar II Objective 6*: Build capacity to manage disasters and environmental challenges	*Water* • No current or pipeline operations *DRM* • DRM Subcomponent of Local Government Strengthening Project (P118026) • CAPRA TAP – San Salvador (seismic risk of metropolitan area)	*Proposed or Pipe Lending or TA (World Bank)* • IUWM Greater San Salvador • Country Environmental Review *Additional Activities (Other Partners)* • IDB, JICA, GIZ support the implementation of the National Climate Change Strategy • AECID/FCAS - WSS Infrastructure in rural and peri-urban areas project, Water Resources Governance and Management Planning Plan, WSS in Rural Areas Project, and Integrated Water, Sanitation and Environment Project • IDB-Expansion and Improvement of Rural WSS Services, Financing Access to Drinking Water and Sanitation Systems, RWSS Program, Proposal for Reduction of Vulnerability in Informal Urban Neighborhoods, and Comprehensive Fiscal Sustainability and CCA Program

<table>
<tr><td rowspan="4">Guatemala</td><td colspan="3">Client Priorities for Integration of DRM and CCA in WSS Sector</td></tr>
<tr><td>CCA & DRM / WSS Challenges</td><td>Existing Country Programs, Policies, and Plans</td><td>Priorities Identified by Clients</td></tr>
<tr><td><u>Key Disaster/Climate Risk Challenge</u>
• World's ninth most affected country to extreme weather events from 1994-2013. (Germanwatch)
• More chronic levels of water scarcity experienced in areas within the Dry Corridor.
• Seismic risk along Pacific coast.

<u>Key WSS Challenges</u>
• While MDG targets regarding access to improved water supply have been met, disparities remain between urban (98 percent) and rural (89 percent) areas.
• Current urban (88 percent) and rural (72 percent) improved sanitation coverage rates have yet to be meet MDG targets.

<u>Key Institutional Challenges</u>
• The DRM framework has explicit mention of the WSS sector; however, there is no evidence of WSS legal and policy instruments which include DRM and/or CCA considerations.</td><td><u>Responsible Entities</u>
• National Coordinator for Disaster Risk Reduction (CONRED)

<u>Relevant Plans/Policies</u>
• Secretariat of Planning and Programming of the Presidency (SEGEPLAN) has developed guidelines for integrating risk management in sectoral and institutional planning process.</td><td><u>General Risk Management</u>
• Develop and strengthen capacities of WSS service providers to implement DRM and CCA activities.</td></tr>
<tr><td colspan="3">Opportunities for World Bank Engagement</td></tr>
<tr><td>Country Partnership Strategy / Framework</td><td>Existing Engagement DRM/Water</td><td>Proposed Activities for Engagement</td></tr>
<tr><td><u>CPS FY13-FY16</u>
• <u>Pillar I Objective 4:</u> Environment and DRM (respond effectively and quickly to natural disasters)</td><td><u>Water</u>
• No current or pipeline operations

<u>DRM</u>
• No current or pipeline operations</td><td><u>Pipeline Lending or TA (World Bank)</u>
• No current or pipeline operations

<u>Additional Activities (Other Partners)</u>
• AECID/FCAS - supports a number of projects to improve access and management of WSS services in indigenous rural communities, and for integrated water management, and has a regional project for rainwater harvesting in four countries including Guatemala
• IDB-ACC and Indigenous People, Support to the National CC program, Integral Disaster Risk Management Capacity Strengthening, WSS Program for Human Development, and Rural Water Investment Program</td></tr>
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<tr><td rowspan="5">Honduras</td><td colspan="3">Client Priorities for Integration of DRM and CCA in WSS Sector</td></tr>
<tr><td>CCA & DRM / WSS Challenges</td><td>Existing Country Programs, Policies, and Plans</td><td>Priorities Identified by Clients</td></tr>
<tr><td><u>Key Disaster/Climate Risk Challenges</u>
• World's most affected country to extreme weather events from 1994-2013. (Germanwatch)
• Honduras represents the largest proportion of the Dry Corridor. (42.1 percent of total area). More chronic levels of water scarcity experienced in areas within the Dry Corridor.
• High hurricane threat along the north coast.
<u>Key WSS Challenges</u>
• MDG WSS targets have been met, but disparities between urban and rural areas in improved water (96 percent vs. 81 percent) and sanitation (86 percent vs. 74 percent) access rates remain significant.
<u>Key Institutional Challenges</u>
• While SANAA is represented in the SNGR, the WSS sector is not fully represented in the national DRM framework.</td><td><u>Responsible Entities</u>
• National Disaster Risk Management System (SINAGER)
<u>Relevant Plans/Policies</u>
• SANAA (2009) - "Contingency Plan for Conception and Laureles Reservoirs"
• SANAA (2011) "Operational Continuity Plan – Threat: epidemics / pandemics"</td><td><u>Risk Identification</u>
• As an urgent action, conduct vulnerability studies and implement climate change adaptation measures of the WSS sector.
<u>Risk Reduction</u>
• Develop technical instruments meant to safeguard WSS projects, which complement general instruments developed by Ministry of Finance for public planning and investment.
<u>Financial Protection</u>
• Value the risk and cost of WSS infrastructure exposed to risk, to enable the design and scaling up of financial protection instruments.</td></tr>
<tr><td colspan="3">Opportunities for World Bank Engagement</td></tr>
<tr><td>Country Partnership Strategy / Framework</td><td>Existing Engagement DRM/Water</td><td>Proposed Activities for Engagement</td></tr>
<tr><td><u>CPS FY12-FY14</u>
• <u>Pillar II Objective 5</u>: More effective DRM</td><td><u>Water</u>
• PROMOSAS (P103881) / AF (P144357)
• Rural Infrastructure Project PIR (P086775) / AF (P144324)
• TA - Support Basin-Based Sanitation Planning in Honduras (P132282)
• IUWM in the Greater Tegucigalpa Area (P125903)
<u>DRM</u>
• DRM Project (P131094)
• Honduras and Nicaragua Catastrophe Risk Insurance Project (P149895)
• TA - Considering Climate Change and Disaster Resilience for Decision Making in Nicaragua and Honduras (P153847)</td><td><u>Proposed or Pipeline Lending or TA (World Bank)</u>
• WSS Service Delivery for Urban Poor in Tegucigalpa
• TA - Strengthening Climate Information and Early Warning Systems to Support Climate-Resilient Development in Nicaragua and Honduras (P155112)
• TA - Promote Landscape approach to Water Security through Payments for Environmental Services in Nicaragua and Honduras

<u>Additional Activities (Other Partners)</u>
• PNUD -Climate Risk Management –
• SDC - Aguasan Program - Mainstreaming CCA and DRM into Community Water Resource Management
• CABEI - Modernization and Equipment for Environmental Observation and Civil Protection Project
• AECID/FCAS - Drainage Master Plan in Santa Rosa Copan, RWSS Program, WSS in Comayagua Valley Project, Access Expansion to WSS and Integrated Management of the Goascoran River Watershed, and the Public Management and Access to WSS Improvement in Ciudad de Gracias Project
• IDB - Supplemental WSS Investment Program, WSS Investment Program, and Disaster Risk Prevention and Mitigation Project</td></tr>
</table>

Nicaragua

Client Priorities for Integration of DRM and CCA in WSS Sector

CCA & DRM / WSS Challenges	Existing Country Programs, Policies, and Plans	Priorities Identified by Clients
Key Disaster/Climate Risk Challenge • Considered the world's fourth most affected country to extreme weather events from 1994-2013. (Germanwatch) • Climate change will likely increase frequency and intensity of extreme rains, floods and drought. • More chronic levels of water scarcity experienced in areas within the Dry Corridor. • Significant hurricane threat along northern Caribbean coast, and seismic threat along Pacific coast. *Key WSS Challenges* • On track in meeting MDG water target, while not on track in meeting MDG sanitation target. • Very significant disparity between urban (98 percent) and rural (68 percent) improved water access rates. • Extremely low coverage rates in urban (63 percent) and rural (37 percent) improved sanitation access. *Key Institutional Challenges* • National WSS regulator (INAA) and not major service providers represented in the SNGR.	*Responsible Entities* • National Disaster Prevention, Mitigation, and Response System (SINAPRED) *Relevant Plans/Policies* • 2008-2012 Institutional Development Plan – Strategic sectoral proposal Preparation and Response Plan for Drinking Water, Sanitation, and Hygiene for Emergency and Disaster Situations in Nicaragua – Draft	*General Risk Management* • Operationalize DRM and CCA actions included in the Water and Sanitation Sector Master Plan 2012-2017 (*Plan Maestro de APS 2012-2017*), currently being prepared by ENACAL *Risk Identification* • Various ENACAL-administered WSS systems maintain cadastral information which would permit the application of probabilistic risk assessment methodologies, such as CAPRA for seismic hazard and PIEVC for climate change. *Risk Reduction* • Develop master plans for drainage in urban areas to reduce risk to WSS services.

Opportunities for World Bank Engagement

Country Partnership Strategy / Framework	Existing Engagement DRM/Water	Proposed Activities for Engagement
CPS FY13-FY17 • *Objective 5:* Transversal challenges (gender, indigenous and Afro-descendant peoples, climate and DRM (water, land use, forestry), transparency)	*Water* • PROSARS - Sustainable Rural Water Supply and Sanitation Sector (P147006) *CCA* • Adaptation of Nicaragua's Water Supplies to Climate Change Project (P127088, GEF Grant) *DRM* • TA - Considering Climate Change and Disaster Resilience for Decision Making in Nicaragua and Honduras (P153847) • Hurricane Felix Emergency Recovery Project (P108974, ICR Stage) • Honduras and Nicaragua Catastrophe Risk Insurance Project (P149895)	*Pipeline or Proposed Lending or TA (World Bank)* • Flood Management in Managua • TA - Strengthening Climate Information and Early Warning Systems to Support Climate-Resilient Development in Nicaragua and Honduras (P155112) • TA - Promote Landscape approach to Water Security through Payments for Environmental Services in Nicaragua and Honduras *Additional Activities (Other Partners)* • SDC Capacity Building on Risk Analysis and Tools to Mainstream DRM & CCA into the project cycle tailored to ENACAL, FISE and the Municipalities of Matagalpa and Jinotega • SDC Support the Ministry of Finance to incorporate CCA and DRM into investment norms • SDC Mainstreaming CCA and DRM into Community Water Resource Management in North Nicaragua • SDC-BID Flood Management Drainage in Las Segovias • IDB –WSS, Stormwater Drainage, and Management in the Watershed III in Managua, WSS Investment Program, Environmental Program for CC and DRM • AECID/FCAS – WSS Improvement in Masaya and Chinandega, Water Resources Conservation in Rural Communities.

<table>
<tr><td rowspan="4">Panama</td><td colspan="3">Client Priorities for Integration of DRM and CCA in WSS Sector</td></tr>
<tr><td>CCA & DRM / WSS Challenges</td><td>Existing Country Programs, Policies, and Plans</td><td>Priorities Identified by Clients</td></tr>
<tr><td><u>Key Disaster/Climate Risk Challenges</u>
• Climate change will likely increase frequency and intensity of extreme rains, floods and drought.
• Moderate levels of seismic activity along the border with Colombia.

<u>Key WSS Challenges</u>
• While MDG target for water has been met, progress insufficient in meeting MDG sanitation target.
• Rural sanitation coverage rate (54 percent) significantly lower than urban coverage rate (77 percent)

<u>Key Institutional Challenges</u>
• As with all Central American countries, WSS infrastructure and services not explicitly identified as critical, essential or vital services for DRM.</td><td><u>Responsible Entities</u>
• National Platform for Disaster Risk Reduction (PNRRD)

<u>Relevant Plans/Policies</u>
• National Institute of Aqueducts and Sewers (IDAAN) – Strategic Plan 2012 IDAAN Crisis Plan</td><td><u>General Risk Management</u>
• Define roles and responsibilities of different institutions with respect to select DRM actions in the new legal and institutional WSS frameworks.

<u>Risk Reduction</u>
• Develop instruments and tools which permit the incorporation of risk management in rural WSS systems.

<u>Preparedness</u>
• Clearly define the roles and responsibilities of WSS institutions in the SINAPROC framework.
• Expand current work carried out by IDAAN regarding contingency plans, to better understand the existing vulnerability as well as necessary prevention and mitigation actions required to reduce risk of WSS systems.</td></tr>
<tr><td colspan="3">Opportunities for World Bank Engagement</td></tr>
<tr><td>Country Partnership Strategy / Framework</td><td>Existing Engagement DRM/Water</td><td>Proposed Activities for Engagement</td></tr>
<tr><td><u>CPF FY15-FY21</u>
• <u>Objective 6</u>: Strengthen resilience to natural disasters

• <u>Objective 7</u>: Support integrated water resources management in priority areas</td><td><u>Water</u>
• Metro Water and Sanitation Improvement Project (P119694)

<u>DRM</u>
• Panama Catastrophic Deferred Draw Down Option (P122738)
• CAPRA TAP – David, Panama (seismic risk of health, education and housing sectors)</td><td><u>Pipeline or Proposed Lending or TA (World Bank)</u>
• Panama Oeste Wastewater Management Project (P154275)
• Improving Sanitary Conditions for Panama City's Urban Poor
• TA - Applying IUWM in Colon, Panama (P154539)
Pilot Water Resources Management Plans in Selected Basins in Panama

<u>Additional Activities (Other Partners)</u>
• IDB - Support to Preparation Program for Reducing Vulnerability of Risk to Natural Disaster and Climate Change, IDAAN Water and Sanitation Investment Program-Phase I, WSS Sector Sustainable Development Program, Panama City and Bay Sanitation Project I
• AECID/FCAS – Rural and Indigenous WSS program</td></tr>
</table>

Regional

Client Priorities for Integration of DRM and CCA in WSS Sector

CCA & DRM / WSS Challenges	Existing Country Programs, Policies, and Plans	Priorities Identified by Clients
Key Disaster/Climate Risk Challenge • One of the world's most vulnerable sub-regions to extreme weather events. • Climate change vulnerability appears to be on the rise, with increases in temperature and significant changes in precipitation and rainfall distribution patterns observed. • More prolonged droughts in El Niño periods and more intense rains, hurricanes and storms in La Niña periods. *Key WSS Challenges* • Urban-rural disparities have significantly reduced over the last decade, but gaps in urban and rural coverage rates persist. • Service quality and efficiency remain poor in the sub-region. • An investment gap of US$864 million has been estimated between current annual investment and the level needed to meet medium-term national targets for WSS in El Salvador, Honduras, and Panama alone. *Key Institutional Challenges* • Highly inflexible, very centralized and generally weak WSS legal frameworks • FOCARD-APS not integrated in the ongoing regional initiatives for DRM and CCA.	*Responsible Entities* • FOCARD-APS • CEPREDENAC • COSEFIN *Relevant Plans/Policies* • Declaration of Comalapa • PCGIR • ERCC • MEGIRC • FOCEGIR • PARCA • PREVDA • FOCARD-APS Strategic Plan 2015-2020	*General Risk Management* • Define roles and responsibilities of SICA regional bodies and instruments with respect to CCA and DRM actions in the WSS sector. *Risk Identification* • Promote shared monitoring of hydrometeorological and climate information *Risk Reduction* • Reduce the vulnerability to climate change and climate variability of water resources and associated infrastructure (ERCC). *Preparedness* • Review national and regional development plans of the WSS sector which explicitly consider DRM and CCA. *Financial Protection* • Develop regulatory models which permit the incorporation of economic instruments and environmental management tools.

Opportunities for World Bank Engagement

Country Partnership Strategy / Framework	Existing Engagement DRM/Water	Proposed Activities for Engagement
Strategies • Strategy detailed in the *Enhancing DRM in CA* PA (P145227) • Strategy detailed in the *Strengthening Water Service Delivery in CA* PA (P153418)	*Water* • Monitoring Country Progress in Water Supply and Sanitation (MAPAS) in Central America – Phase II • Regional Agenda and Action Plans for Sanitation in Central America • Status of Disaster Risk Management in the Water Supply and Sanitation sector in FOCARD-APS member countries *DRM* • Probabilistic Risk Assessment (CAPRA) (P144982) • Central America and Caribbean Catastrophe Risk Insurance Project (CCRIF) (P149670)	*Pipeline Lending or TA (World Bank)* • Water Availability Studies and WRM in the Dry Corridor • TA-Building Water Sector Capacity for Climate Change Adaptation and Disaster Risk Management • Technical Assistance Project (TAP) to strengthen resilience of Urban WSS utilities by developing a seismic risk assessment of WSS infrastructure under the CAPRA Program (P144982) • Technical Assistance and Capacity Building for Disaster Risk Financing and Insurance. *Additional Activities (Other Partners)* • SDC - Support CEPREDENAC for the promotion and harmonization of the PCGIR in Central American countries • SCD – Support the Central American Superior Council of Universities (CSUCA) and Central American Universities in the implementation of a post graduate degree in Disaster Risk Reduction in Sanitation

Annex 1: Brief Summary of Actors in DRM and the WSS Sector

The WSS Institutional Landscape in Central America and the Dominican Republic

A number of actors play a key role in the direction, regulation, and delivery of water and sanitation services (WSS) in rural and urban areas. Table 1 provides an overview of the principal institutions in FOCARD-APS countries organized by role. The lead agencies of WSS services in Costa Rica, El Salvador, Guatemala, Nicaragua (rural), Panama, and the Dominican Republic is an agency focused on either health and/or social assistance, which has significant implications on what aspect of WSS services is prioritized. Only in Honduras is the agency responsible for WSS infrastructure and service delivery exclusively focused on WSS.

It is also significant that countries such as El Salvador, Guatemala, and the Dominican Republic lack a regulator and have no other institutions tasked with such a function. Technical standards for the design and operations of WSS services in these countries therefore correspond to technical tools developed by the leading provider of these services, such as INFOM in Guatemala or INAP in the Dominican Republic.

Table 1. Principal Institutions of the WSS Sector in Central America and the Dominican Republic

Country	Lead Agency	Regulator	Urban Service Providers	Rural Service Providers
Costa Rica	Ministry of Health	ARESEP	AyA, ESPH	ASADAS, community water boards
El Salvador	Ministry of Health ANDA (urban) FISDL (rural)	Nonexistent	ANDA	Community water boards, ADESCO
Guatemala	Ministry of Public Health and Social Assistance (MSPAS)	Nonexistent	Municipalities, EMPAGUA, municipal service companies	INFOM, municipalities, community water boards
Honduras	CONASA	ERSAPS	SANAA, autonomous municipal service providers, municipalities, private providers, urban committees/patronages	Rural committees
Nicaragua	ANA, Nuevo FISE (rural)	INAA	EMAPS	Community water boards
Panama	Ministry of Health	ASEP	IDAAN, municipalities, Panama Canal Authority, private providers	Community water boards
Dominican Republic	Ministry of Health	Nonexistent	INAPA, regional water boards	Community water boards

The DRM Institutional Landscape in Central America and the Dominican Republic

The National Systems of Disaster Risk Management (*Sistemas Nacionales de Gestión de Riesgo de Desastres* or SNGR) maintain their own legal and institutional frameworks, in which one leading institution is identified and responsibilities are assigned on the basis of institutional and sectoral representation**.**

As detailed in table 2, the national representation and lead agencies of the WSS sector in these SNGRs variy between countries. In most cases, the country's largest WSS service provider is represented, as with AyA (Costa Rica) and to a lesser degree, INAPA (Dominican Republic) and SANAA (Honduras) – entities that are major service providers, but only to a portion of the total national population. However, in Guatemala, the lead agency (MSPAS) and in Nicaragua, the regulator (INAA) represent the WSS sector in the SNGR.

Table 2. Institutions of the National System of DRM and the WSS Sector Participation

Country	National System	Lead Agency of the National System of Risk Management	Representative of the WSS Sector
Costa Rica	National DRM system	National Risk Prevention and Emergency Management Commission (CNE)	AyA
El Salvador	National Civil Protection, Disaster Risk Prevention and Mitigation System	General Directerate for Civil Protection, Disaster Risk Prevention and Mitigation	ANDA
Guatemala	National Coordination for Disaster Reduction (CONRED)	Executive Secretary SE-CONRED	MSPAS, INFOM
Honduras	National Risk Management System (SINAGER)	Permanent Contingency Commission (COPECO)	SANAA
Nicaragua	National System for Disasters Prevention, Mitigation and Response (SINAPRED)	Executive Secretary SE-SINAPRED	ENACAL, INAA
Panama	National Platform for Disaster Risk Reduction (PNRRD)	National Civil Protection System (SINAPROC)	IDAAN
Dominican Republic	National Disaster Prevention, Mitigation, and Response System (SN-PMR)	National Risk Prevention and Emergency Management Commission (CNE)	INAPA, CAASD

a. The participation of ANDA as the representative of the WSS sector in the national DRM system is not reflected in the legal framework
b. SANAA provides WSS services only to only 20 percent of the population in Honduras.
c. The WSS Corporation of Santo Domingo (CAASD) participates together INAPA in the national DRM system on regular basis.

On the basis of the information in the table, it is apparent that the WSS institutions that represent the sector at the national level in the SNGRs do not always speak for the entire sector. As a result, sometimes the representative institutions advocate and pursue actions that largely focus on their own institution or constituency they serve. Thus, the sector as a whole

often does not benefit from the coordination, initiatives, and knowledge generated from the SNGR frameworks.

It is also worth highlighting that although in all FOCARD-APS members at least one WSS institution participates in national DRM platforms, only Guatemala, Nicaragua, and the Dominican Republic have explicit mention of said institutions in their respective DRM frameworks.

It is important to note that a number of actors, policies, and initiatives exist that bring together the DRM, CCA, and WSS agendas in Central America and the Dominican Republic. Table 3 summarizes main regional initiatives in which FOCARD should be involved

Table 3. Regional Institutions and Initiatives

Regional Institutions	Regional Initiatives
CEPREDENAC	PCGIR – Central America Policy for Integrated Disaster Risk Management (June 2010) is the most significant regional public policy instrument on the theme of disaster risk management and is considered one of five key pillars in SICA's prioritized agenda.
CEPREDENAC	The Fund for Promotion of Integrated Climate Risk Management in Central America (FOCEGIR), established in 2011 as a financial mechanism to assist the countries of the region in strengthening their capacity to respond to emergencies and to promote actions of integrated risk management.
CEPREDENAC and CCAD	The Framework for Integrated Climate Risk Management (MEGIRC), which integrates DRM and climate change adaptation (CCA).
SICA Environmental Subsystem, composed of the CCAD, CRRH, and CEPREDENAC	Environmental authorities have adopted a formal Water Agenda and developed a Strategy for Integrated Water Resources Management to address these challenges at the regional level, using a broad range of instruments including the Central American Water Covenant (CONVERGIRH), the Central American Integrated Water Resources Management Strategy (ECAGIRH), and the Central American Integrated Water Resources Management Plan (PACAGIRH). These instruments will be mirrored in all countries, where increasing pressure on scarce water resources is likely to lead to further interest at the political level in water resources management.

Annex 2: Country-Specific Assessments

Costa Rica

Country Assessments

Climate Change Adaptation and Disaster Risk Management in the Water and Sanitation Sector

Legend	No data reported	Good progress Score > 2	Moderate progress 1 > Score < 2	No evidence of progress found Score < 1

	ELEMENT OF ANALYSIS	2013	2014	Source of Verification	Comment
POLICY AND REGULATORY INSTRUMENTS	Do the disaster risk management (DRM) and climate change legal frameworks consider the water and sanitation (WSS) sector?			National Risk Prevention and Emergency Response Law. Gazette No. 8, 11 January 2006, Law 8488.	
	What institution represents the WSS sector in national disaster risk management forums?			AyA – Technical Advisory Committee (CAT) of Engineering and Risk, and CAT of Hydrology and Geomorphology, comprised of: AyA and the Institute of Development and Municipal Advisory (IFAM). Gazette No. 8, 11 January 2006: Law 8488.	The Public Services Company of Heredia (ESPH) should be incorporated in the Technical Advisory Committee (CAT) structure.
	Does the WSS legal framework take into account disaster risk management and climate change adaptation considerations?			Regulation for Drinking Water Quality. Gazette No. 84, 3 May 2005, Executive Decree No. 32327-S Public Service Regulatory Authority Law. Gazette No. 156, 13 August 2008, Law 7593. National Risk Prevention and Emergency Response Law. Gazette No. 8, 11 January 2006, Law 8488.	
	Are disaster risk management and climate change adaptation considered during planning processes in the WSS sector?			National Risk Prevention and Emergency Response Commission (CNE, www.cne.go.cr) - National Disaster Risk Management Plan 2010-2015. Regulation of technical standards and procedures for preventive maintenance of water supply systems (2010). Model for valuation of vulnerability to disaster risk and natural hazards. Gazette No. 159, 19 August 2011, Executive Decree No. 36721-MP National Plan for Integrated Water Resources Management in Costa Rica (2005), Ministry of Environment, Energy, and Telecommunications (MINAET). National Climate Change Strategy. 1st Edition. Gazette No. 89, 10 May 2013. National Territorial Planning Policy 2012-2040. Gazette No. 89, 10 May 2013, Executive Decree No. 37623. MINAET (2009), National Water Resource Policy. MINAET, Strategy for Integrated Water Resources Management (EGIRH) in Costa Rica. MINAET (2008), Climate, Variability, and Climate Change in Costa Rica. National Meteorological Institute (IMN), Regional Committee on Water Resources (CRRH), and UNDP.	Improvement of national capacity to assess vulnerability and adaptation of water systems to climate change in Costa Rica as a means to mitigate climate change risk and improve the Human Development Index.
	Do national or sectoral planning instruments or the national public investment system norms take DRM and CCA into account in the planning, design, and construction of WSS services?			General methodological guide for the identification, formulation, and evaluation of public investment projects. CR 332.67 C8375g, Ministry of National Planning and Economic Policy (MIDEPLAN), Public Investment Division. MIDEPLAN (2012) - Methodological guide for the development and evaluation of public investment projects in water and sanitation in Costa Rica. Institute of Aqueducts and Sewers (AyA) - Regulations for technical standards and procedures for preventive maintenance for water supply systems. 2001-175.	

	ELEMENT OF ANALYSIS	2013	2014	Source of Verification	Comment
				Gazette No. 154, 13 August 2001	
	Are WSS infrastructure and services explicitly identified as critical, essential, or vital services for disaster risk management?			AyA (2008) – Risk assessment studies for WSS systems.	

	ELEMENT OF ANALYSIS	2013	2014	Source of Verification	Comment
DESIGN AND OPERATION CODES AND STANDARDS	Do design and construction codes and standards for WSS infrastructure incorporate DRM and CCA aspects?			Design Standards of Drinking Water Infrastructure. AyA Executive Committee. Gazette No. 185, 26 September 2001. Seismic code of Costa Rica. Gazette No. 136, 13 July 2012, Digital Version No 94.	Design standards require update to include aspects of risk.
	Risk identification			AyA (2012), Methodological guide for the development and evaluation of public investment projects in water and sanitation in Costa Rica. AyA (2012), Seismic evaluation of drinking water and sanitation systems in the Greater Metropolitan Area of San Isidro and Higuito. AyA, World Bank, ERN. AyA (2011), Climate Vulnerability Assessment of the Wastewater Collection, Treatment, and Disposal System in the City of Limón, Costa Rica, applying the Public Infrastructure Engineering Vulnerability Committee (PIEVC) protocol. AyA, Federated Association of Engineers and Architects (CfIA), National Meteorological Institute (IMN), Engineers Canada.	
	Risk reduction			Regulations for technical standards and procedures for preventive maintenance for water supply systems. Gazette No. 154, 13 August 2011. Municipal Disaster Risk Management. Standards and basic elements for inclusion in land use planning, with emphasis on prevention, control, and land planning. 2014.	
	Preparedness			AyA (2013) - Manual of Risk Management and procedures for Emergency and Disaster Response, 57 pages (Internal report).	
	Financial protection			CNE (2010) - National Disaster Risk Management Plan (Internal report).	
	Resilient reconstruction			CNE General Emergency Plan. Gazette No 8, 11 January 2006, Law 8488, National Emergency and Risk Prevention Law.	
	Are monitoring and control mechanisms in place to ensure compliance with standards?			Monitoring and control mechanisms established by the Ministry of Health (MINSALUD), the Pan American Health Organization (PAHO/WHO), CfIA, laboratories of Public Universities (UCR, UNA, TEC), National Water Laboratory.	

a. http://www.pievc.ca.
b. National organization of the 12 engineering regulators that license the country's 280,000 members of the profession in Canada (http://www.engineerscanada.ca/.

	ELEMENT OF ANALYSIS	2013	2014	Source of Verification	Comments
RISK IDENTIFICATION (Threat, Exposure, and Vulnerability)	Do WSS institutions have access to reliable and updated information about the risks present in the country?			OVSICORI; National Meteorological Institute; University of Costa Rica (UCR); National Seismology Network; the UCR Seismic Engineering Laboratory; Costa Rica Institute of Electricity (ICE); CAT of Engineering and Risk within CNE.	
	Do WSS institutions have cadastral information systems and keep an updated registry of the location and characteristics of the main components of the WSS systems?			AyA (2007), Water usage rights; water intakes for regional water supply and sanitation services (internal report). The Water Department has the geographic registries of AyA water supplies as well as for select sources managed by ASADAS, ESPH, JASEC, and other private providers.	
	Do WSS institutions have mechanisms for monitoring the system to identify network and main components failures?			Building off of risk management platforms (e.g., Probabilistic Risk Assessment CAPRA – seismic platform), systems for real-time response should be developed.	
	Have WSS institutions generated information on how events/emergencies have altered system functionality?			MIDEPLAN (2010), The economic impact of natural disasters and extreme events in Costa Rica, 1988-2009.	
	Have studies been carried out on the risk or (functional) vulnerability in the WSS sector?			AyA (1997), Vulnerability Assessment of the Orosi Water Supply System. AyA (2012), CAPRA – Physical Assessment of drinking water and sanitation systems in the Greater Metropolitan Area, San Pedro Perez Zeledon, Higuito de Desamparados (internal report). AyA (2011), PIEVC - Climate Vulnerability Assessment of the Wastewater Collection, Treatment, and Disposal System in the City of Limón, Costa Rica. Functional vulnerability is considered (internal report).	
	Do workforce development plans in the WSS sector include opportunities for training in disaster risk management?			Individual plans from various institutions and offered by universities.	
RISK REDUCTION	Does the primary WSS service provider have a DRM unit or department?			AyA, Disaster Risk Management Division (since 2005). Currently linked to the Research and Development Unit of the Sub-Directorate of Environment, Investigation, and Development. ESPH has personnel trained in disaster risk management within the Department of Planning.	AyA - Applied research on toxic substances under development with CAPRA and PIEV instruments.
	Do the primary WSS service provider's operation and maintenance plans take into account aspects related to emergencies and risk management?			Regulations for technical standards and procedures for preventive maintenance of water supply systems. Gazette No. 154, 13 August 2001.	
	Has funding been assigned for activities specifically related to DRM?				At the AyA level.

	Have concrete actions to reduce vulnerability in WSS systems been either planned or undertaken?			AyA, Regional workshops, 2012–2013.	
	Have threat and risk evaluations been included in the construction of new infrastructure?			Strengthening of the Fifth Stage of the San Jose Metropolitan Drinking Water System (Orosi-II) Project. Costa Rican Seismic Code recommends specific studies for special works and critical lifelines.	RESS II - Seismic Risk Reduction in Central America, 2009. Norwegian Agency for Development Cooperation.

	ELEMENT OF ANALYSIS	2013	2014	Source of Verification	Comments
PREPAREDNESS	Does the WSS sector have emergency/contingency plans linked to national/local emergency plans?			Although WSS sector emergency plans exist, they are neither updated nor articulated with the national plans developed by the CNE.	
	Have competent institutions been identified for WSS response, including an assessment of their respective strengths and capacities for response?			AyA (as lead WSS institution) and CNE; in addition, the Communal Water Systems (ASADAS) and other operators such as the Public Services Company of Heredia (ESPH).	AyA understands response as well as efficient and effective emergency management very well. However, all WSS sector institutions should be evaluated in order to respond to this question properly.
	Does the country have specific national coordination mechanisms for WSS institutions and actors?			CNE, Emergency Operations Center, with support from CATs. National Emergency and Risk Prevention Law. Gazette No. 8, 11 January 2006, Law 8488. INM, Semiannual Climate forecast report.	
	Are tools and procedures available for damage assessment and needs analysis (DANA) of WSS systems?			CNE (as lead DRM institution) has general tools to conduct damage and needs assessment. AyA (as lead WSS institution) implemented technical factsheets for the evaluation of WSS systems.	In process of internal review by AyA, with eventual dissemination to water service providers.

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Approved by: Dr. Luis Carlos Vargas Fallas – AyA

	ELEMENT OF ANALYSIS	2013	2014	Source of Verification	Comment
POLICY AND REGULATORY INSTRUMENTS	Do the disaster risk management and climate change legal frameworks consider the WSS sector?			Law 147-02 – Disaster Risk Management. Specific functions assigned to the National Institute of Drinking Water and Sewers (INAPA).	
	What institution represents the WSS sector in national disaster risk management forums?			National Institute of Drinking Water and Sanitation (INAPA).	
	Does the WSS legal framework take into account disaster risk management and climate change adaptation considerations?			The WSS law under development takes disaster risk management and climate change adaptation into account.	
	Are disaster risk management and climate change adaptation considered during planning processes in the WSS sector?			National System for Public Investments (SNIP), Technical Standards. INAPA, Methodological Guidelines for Investment Project Planning and Management.	DRM and CCA are considered by SNIP for project approval.
	Do national or sectoral planning instruments or the national public investment system norms take DRM and CCA into account in the planning, design, and construction of WSS services?			National Integrated Disaster Risk Management Plan (2011). National Seismic Risk Reduction Plan (2011). Multiyear Plan 2013-2016. INAPA National Emergency Plan.	INAPA identified as key actor.
	Are WSS infrastructure and services explicitly identified as critical, essential, or vital services for disaster risk management?			Law 147-02, concerning disaster risk management. Regulation 874-09 on disaster risk management (2009). Law 1-12, National Development Strategy. INAPA National Emergency Plan.	Art. 4 Definitions. 11 Vital Lines include water systems, sewers, treatment plants, and irrigation channels among basic services.
DESIGN AND OPERATION CODES AND STANDARDS	Do design and construction codes and standards for WSS infrastructure incorporate DRM and CCA aspects?			Design standards for climate change adaptation and DRM are being reviewed but have yet to be approved by INAPA.	
	Risk identification				No evidence was found in the codes or standards analyzed.
	Risk reduction				No evidence was found in the codes or standards analyzed.
	Preparedness				No evidence was found in the codes or standards analyzed.
	Financial protection				No evidence was found in the codes or standards analyzed.
	Resilient reconstruction				No evidence was found in the codes or standards analyzed.
	Are monitoring and control mechanisms in place to ensure compliance with standards?			There are two pilot projects for the protection of the Cueva and Vallejuelo watershed.	

	ELEMENT OF ANALYSIS	2013	2014	Source of Verification	Comments
RISK IDENTIFICATION (Threat, Exposure, and Vulnerability)	Do WSS institutions have access to reliable and updated information about the risks present in the country?			National Meteorology Office (ONAMET); National Institute of Water Resources (INDRHI); University Seismic Institute; National Geological Service.	
	Do WSS institutions have cadastral information systems and keep an updated registry of the location and characteristics of the main components of the WSS systems?			INAPA – Water Quality and Treatment Monitoring System (SISMOPA). Geo-referenced data on drinking water quality being gathered for more than 10 provinces. Information System for Rural Water and Sanitation (SIASAR) – INAPA is gathering information on RWSS systems nationwide.	
	Do WSS institutions have mechanisms for monitoring the system to identify network and main components failures?				Not evaluated due to lack of access to relevant information.
	Have WSS institutions generated information on how events/emergencies have altered system functionality?			Emergency Plan for INAPA. Emergency Plan for San Juan de la Maguana.	"Coordination in Action - WASH Group impact during the cholera epidemic" ECHO (2012)
	Have studies been carried out on the risk or (functional) vulnerability in the WSS sector?			Mitigation Plan for Water Supply in the Northeast Region (2011).	
	Do workforce development plans in the WSS sector include opportunities for training in disaster risk management?			Capacity building under way through the Ministry of Environment, GIZ, ECHO, UNDP, National Commission for Climate Change Adaptation.	
RISK REDUCTION	Does the primary WSS service provider have a DRM unit or department?			INAPA - Environmental and Disaster Risk Management Department created in 2012.	
	Do the primary WSS service provider's operation and maintenance plans take into account aspects related to emergencies and risk management?			Service providers O&M plans take into account emergency and risk management aspects, but they have not been updated.	
	Has funding been assigned for activities specifically related to DRM?			No evidence was found. Resources yet to be assigned.	
	Have concrete actions to reduce vulnerability in WSS systems been either planned or undertaken?			Actions have been carried out on an ad hoc basis during system failures.	
	Have threat and risk evaluations been included in the construction of new infrastructure?			Work in progress.	

a. http://www.siasar.org

	ELEMENT OF ANALYSIS	2013	2014	Source of Verification	Comments
PREPAREDNESS	Does the WSS sector have emergency/contingency plans linked to national/local emergency plans?			INAPA Institutional Plan. INAPA Emergency Manual for Disaster Situations (1996-2014).	
	Have competent institutions been identified for WSS response, including an assessment of their respective strengths and capacities for response?			No analysis of WSS actors and capacities has been carried out. Considered under INAPA Emergency Plan.	
	Does the country have specific national coordination mechanisms for WSS institutions and actors?			Operation and Emergency Center (COE) - Roundtable for Water, Sanitation and Hygiene, with participation of the Regional Water and Sanitation Corporations (CORAAs), INAPA, and Ministry of Public Health.	COE WASH Roundtable established after the Noel Storm (Nov 2007).
	Are tools and procedures available for damage assessment and needs analysis (DANA) of WSS systems?			Forms included in the 'Guide for Effective Response' developed by the Pan American Health Organization (PAHO) and the Inter-American Association of Sanitary and Environmental Engineering (AIDIS).	

El Salvador

Country Assessment

Climate Change Adaptation and Disaster Risk Management in the Water and Sanitation Sector

	ELEMENT OF ANALYSIS	2013	2014	Source of Verification	Comment
POLICY AND REGULATORY INSTRUMENTS	Do the disaster risk management and climate change legal frameworks consider the WSS sector?			Decree 777 – Civil Protection, Prevention, and Disaster Mitigation Law (Art. 5).	
	What institution represents the WSS sector in national disaster risk management forums?	ANDA	ANDA	National Water and Sewerage Network Administration (ANDA).	
	Does the WSS legal framework take into account disaster risk management and climate change adaptation considerations?			Water Law Draft, Art. 8.e. General Principles.	
	Are disaster risk management and climate change adaptation considered during planning processes in the WSS sector?				
	Do national or sectoral planning instruments or the national public investment system norms take DRM and CCA into account in the planning, design, and construction of WSS services?				
	Are WSS infrastructure and services explicitly identified as critical, essential, or vital services for disaster risk management?			WSS services are not explicitly mentioned as being critical, essential, or vital.	
DESIGN AND OPERATION CODES AND STANDARDS	Do design and construction codes and standards for WSS infrastructure incorporate DRM and CCA aspects?			No evidence was found in the codes or standards analyzed for this assessment.	
	Risk identification				
	Risk reduction				
	Preparedness				
	Financial protection			The majority of the WSS infrastructure stock managed by ANDA was insured when the earthquake hit the country in 2011.	The assets' insurance policies have gradually expired and not been renewed.
	Resilient reconstruction				
	Are monitoring and control mechanisms in place to ensure compliance with standards?				

	ELEMENT OF ANALYSIS	2013	2014	Source of Verification	Comments
RISK IDENTIFICATION (Threat, Exposure, and Vulnerability)	Do WSS institutions have access to reliable and updated information about the risks present in the country?			Environmental Observatory of the Ministry of Environment, formerly the National Service of Territorial Studies.	
	Do WSS institutions have cadastral information systems and keep an updated registry of the location and characteristics of the main components of the WSS systems?			The National Water and Sewerage Network Administration (ANDA) is surveying and digitizing the country's cadastral information using geographic information systems (GIS).	
	Do WSS institutions have mechanisms for monitoring the system to identify network and main components failures?			ANDA monitors water quality through the call center as well as daily work schedules throughout the entire drinking water network at the national level.	
	Have WSS institutions generated information on how events/emergencies have altered system functionality?			PAHO/WHO (2003), "Vulnerability of the Drinking Water and Sanitation Systems in Rural Areas of El Salvador."	
	Have studies been carried out on the risk or (functional) vulnerability in the WSS sector?			PAHO/WHO, UCA (2002), "Vulnerability Evaluation of the Water Supply System in El Morro Community."	
	Do workforce development plans in the WSS sector include opportunities for training in disaster risk management?				
RISK REDUCTION	Does the primary WSS service provider have a DRM unit or department?			Risk Management Committee against Threats	
	Do the primary WSS service provider's operation and maintenance plans take into account aspects related to emergencies and risk management?			No information was found	
	Has funding been assigned for activities specifically related to DRM?			No information was found	
	Have concrete actions to reduce vulnerability in WSS been systems either planned or undertaken?				
	Have threat and risk evaluations been included in the construction of new infrastructure?				
PREPAREDNESS	Does the WSS sector have emergency/contingency plans linked to national/local emergency plans?			ANDA – "Institutional Plan for Emergency and Disaster Response" (2004) and "Basic Guidelines for Regional Offices to Develop Plans for Emergency and Disaster Response" (2003).	
	Have competent institutions been identified for WSS response, including an assessment of their respective strengths and capacities for response?				
	Does the country have specific national coordination mechanisms for WSS institutions and actors?				
	Are tools and procedures available for damage assessment and needs analysis (DANA) of WSS systems?			ANDA (2004), "Damage Assessment and Needs Analysis – Core Equipment and Basic Formats."	

	ELEMENT OF ANALYSIS	2013	2014	Source of Verification	Comment
POLICY AND REGULATORY INSTRUMENTS	Do the disaster risk management and climate change legal frameworks consider the WSS sector?			Law 109-96 – National Coordinator for Disaster Risk Reduction (CONRED). National Response Plan. Sector IV: Infrastructure and Basic Services. Water and Sanitation Support Function led by the Ministry of Public Health and Social Assistance (MSAPS), as WSS governing body, with the support of the Municipal Development Institute (INFOM)/Rural Water Supply and Sanitation Project Implementation Unit (UNEPAR), which is responsible for WSS service provision.	CONRED – WASH Technical Roundtable led by the MSAPS.
	What institution represents the WSS sector in national disaster risk management forums?			CONRED, National Response Plan. CONRED, WASH Technical Roundtable	WASH support function led by MSAPS with INFOM support.
	Does the WSS legal framework take into account disaster risk management and climate change adaptation considerations?			CCA and DRM are not referenced in the WSS policy and regulatory frameworks.	UNICEF-led Water Sanitation and Hygiene (WASH) Cluster.
	Are disaster risk management and climate change adaptation considered during planning processes in the WSS sector?			Ministry of Environment and Natural Resources (MARN), "Environmental Guide for the Urban Infrastructure Development Sector."	Under development by the Association of Engineers.
	Do national or sectoral planning instruments or the national public investment system norms take DRM and CCA into account in the planning, design, and construction of WSS services?			Secretariat of Planning and Programming of the Presidency (SEGEPLAN), "Guide for institutional planning process 2012 and multiannual 2012-2014." SEGEPLAN (2012), "Risk Analysis in Public Investments – Guidelines for fixed capital projects."	SEGEPLAN has developed guidelines for integrating risk management in sectoral and institutional planning process.
DESIGN AND OPERATION CODES AND STANDARDS	Do design and construction codes and standards for WSS infrastructure incorporate DRM and CCA aspects?			PAHO (2002), "Study on DRM consideration in technical standards for water and sanitation system design, construction, operation and maintenance."	
	Risk identification			Strategy for Institutional Management in Water and Sanitation (2012).	
	Risk reduction			MSPAS, urban and rural sanitation regulations. MSPAS as regulator and INFORM/UNEPAR as implementer.	
	Preparedness			Ibid. In addition, potable water and wastewater quality standards from the Guatemalan Code for Hydraulic and Sanitary Standards (COGUANOR).	
	Financial protection			CONRED, National Policy for Disaster Risk Reduction. Specific action line is included to "Incentivize insurance and reinsurance coverage of agriculture, real estate, and public and private infrastructure."	
	Resilient reconstruction			CONRED, Construction specifications for drinking water - NR2 - structural demands, site conditions and levels of protection. INFOM, Standards for Design and Execution of Water Supply and Sanitation Projects.	
	Are monitoring and control mechanisms in place to ensure compliance with standards?			INFOM monitors and control only the system it supports, which does not correspond to all services in the country.	

a. http://www.segeplan.gob.gt/downloads/Metodolog%C3%ADa%20planificaci%C3%B3n%202012.pdf.

	ELEMENT OF ANALYSIS	2013	2014	Source of Verification	Comments
RISK IDENTIFICATION (Threat, Exposure, and Vulnerability)	Do WSS institutions have access to reliable and updated information about the risks present in the country?			National Institute for Seismology, Volcanology, Meteorology, and Hydrology (INSIVUMEH).	
	Do WSS institutions have cadastral information systems and keep an updated registry of the location and characteristics of the main components of the WSS systems?			No physical inventory of infrastructure exists. No evidence that service providers keep updated cadastral information of WSS systems was found.	
	Do WSS institutions have mechanisms for monitoring the system to identify network and main components failures?			MSPAS through its health areas and CONRED through its Municipal Emergency and Operation Centers (COE).	CONRED convenes INFOM-UNEPAR and OMAS to respond.
	Have WSS institutions generated information on how events/emergencies have altered system functionality?			EMPAGUA (1999), The El Niño Phenomenon and its Effect on the Drinking Water Supply System in Guatemala City. University of San Carlos, Eris (2008), Damage Due to the storm Stan and water quality assessment in Solola, Guatemala.	
	Have studies been carried out on the risk or (functional) vulnerability in the WSS sector?			PAHO/WHO (2002), Vulnerability Analysis of the Water Supply System in the Municipality of Teculutan, the Department of Zacapa. University of San Carlos, Wilfredo Cano (2006) "Vulnerability Analysis of the Drinking Water System in Santa Catarina Pinula, Guatemala."	
	Do workforce development plans in the WSS sector include opportunities for training in disaster risk management?			No continuous training plans in the WSS sector that include DRM were identified. Included within disaster response plans of the WSS sector.	
RISK REDUCTION	Does the primary WSS service provider have a DRM unit or department?			Only the Municipal Water Company of Guatemala City (EMPAGUA) and the INFOM/UNEPAR have a DRM unit or department.	Other service providers have a DRM-related document related submitted to CONRED.
	Do the primary WSS service provider's operation and maintenance plans take into account aspects related to emergencies and risk management?			Included by the Municipal WSS Offices (OMAS) and each service provider.	
	Has funding been assigned for activities specifically related to DRM?				No evidence was found.
	Have concrete actions to reduce vulnerability in WSS systems been either planned or undertaken?				No evidence was found.
	Have threat and risk evaluations been included in the construction of new infrastructure?			SEGEPLAN, public investment projects. No specific guidance developed by the sector.	No evidence was found.
PREPAREDNESS	Does the WSS sector have emergency/contingency plans linked to national/local emergency plans?			CONRED, National Emergency WASH Plan.	
	Have competent institutions been identified for WSS response, including an assessment of their respective strengths and capacities for response?			Baseline Report, – "Strengthening capacity and coordination of regional and national WASH clusters in disaster prone countries" project (2012). WASH Cluster Guatemala, WASH Preparation and Response Plan (2013).	
	Does the country have specific national coordination mechanisms for WSS institutions and actors?			CONRED, National Response Plan.	
	Are tools and procedures available for damage assessment and needs analysis (DANA) of WSS systems?			CONRED, WASH Technical Roundtable Plan. Initial Damage Assessment form and Complementary Damage Assessment form,	

	ELEMENT OF ANALYSIS	2013	2014	Source of Verification	Comment
POLICY AND REGULATORY INSTRUMENTS	Do the disaster risk management and climate change legal frameworks consider the WSS sector?			National Disaster Risk Management System (SINAGER) Law, Art. 6.19. The National Water and Sewers Autonomous Service (SANAA) is considered a first-response institution and is part of the Permanent Contingency Commission (COPECO).	SANAA integrates the Committees for Lifesaving, Heath, and Damage and Needs Assessment.
	What institution represents the WSS sector in national disaster risk management forums?			SANAA, CONASA.	
	Does the WSS legal framework take into account disaster risk management and climate change adaptation considerations?			National Council for Drinking Water and Sanitation (CONASA, 2013), "National Drinking Water and Sanitation Sector Policy." Guideline 5.2.4. Secretariat of Natural Resources and Environment (SERNA), National Climate Change Adaptation Policy.	
	Are disaster risk management and climate change adaptation considered during planning processes in the WSS sector?			CONASA (2005), Strategic Plan for the Water and Sanitation Sector Modernization	
	Do national or sectoral planning instruments or the national public investment system norms take DRM and CCA into account in the planning, design, and construction of WSS services?			Ministry of Finance (SEFIN), "General Methodological Guide for the Development and Evaluation of Public Investment Programs and Projects." SEFIN, "Sectoral Methodological Guide for the Development and Evaluation of Water and Sanitation Programs and Projects." CONASA (2005), Strategic Plan for the Water and Sanitation Sector Modernization.	
	Are WSS infrastructure and services explicitly identified as critical, essential, or vital services for disaster risk management?			Country Vision 2010-2038, National Plan 2010-2022, Millennium Development Goals (MDG-Honduras). COPECO – SINAGER Law.	
DESIGN AND OPERATION CODES AND STANDARDS	Do design and construction codes and standards for WSS infrastructure incorporate DRM and CCA aspects?				
	Risk identification				No evidence was found in the codes or standards analyzed.
	Risk reduction			WSS Regulator (ERSAPS), "Technical Guide and Protocols for Risk Reduction in Water and Sanitation Services" (2012).	
	Preparedness			Water and Sanitation Sector Framework Law, Decree No 118-2003, Art. 30, Service Providers.	
	Financial protection			National Public Works and Infrastructure Advancement and Development Law, Decree 283-98, Art.24 – SOPTRAVI and Municipalities.	
	Resilient reconstruction				No evidence was found in the codes or standards analyzed.
	Are monitoring and control mechanisms in place to ensure compliance with standards?			Water and Sanitation Sector Framework Law (2003), Art. 9/48. ERSAPS WSS service regulation and control and SANAA technical assistance to municipalities and decentralized service providers. Environmental Law Article 34. SERNA. Regulation of Water Resource.	Effectiveness of mechanisms in place ensuring compliance with standards is not always guaranteed.

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RISK IDENTIFICATION (Threat, Exposure, and Vulnerability)	Do WSS institutions have access to reliable and updated information about the risks present in the country?			National Meteorological Service (SMN), General Directorate of Water Resources (DGRH). Honduras National Land Use Law (Decree 180-2003) (National Land Use Information System – SINIT). COPECO – Early Warning Systems.	
	Do WSS institutions have cadastral information systems and keep an updated registry of the location and characteristics of the main components of the WSS systems?			Honduran Water and Sanitation Network (RAS-HON), Inventory of Wastewater Treatment Plants in Honduras (2009). Municipalities Law, Article 13, Section 4, Construction of WSS networks. SANAA, Metropolitan Water Services, Cadaster of Networks and Users. Cadaster updated through donor-funded projects: Operations Optimization Project (ICEX/AQUARIUM 2011); Network Cadaster and Inventory of Installations (WB PROMOSAS/ BLOMINFO 2012); and Non-Revenue Water (NRW) Project (WB PROMOSAS, 2013). Information System for Rural Water and Sanitation (SIASAR) - SANAA is gathering information on RWSS systems nationwide.	Cadasters are being updated for the main WSS systems in Tegucigalpa and other municipalities.
	Do WSS institutions have mechanisms for monitoring the system to identify network and main components failures?			SANAA - Control center at “El Picacho” plant. Claim Units in each water scheme operated.	
	Have WSS institutions generated information on how events/emergencies have altered system functionality?			PAHO/WHO (2000), “Lessons learned from Hurricane Mitch in WSS services.” PAHO/WHO (2002), “Diagnostic of Water and Sanitation Systems following Hurricane Mitch.” UNDP/SERNA, Climate Variability and Climate Change in Honduras.	
	Have studies been carried out on the risk or (functional) vulnerability in the WSS sector?			Study on Flood Control and Landslide Prevention in the Metropolitan Area of Tegucigalpa (2001-2002) supported by JICA. ERSAPS (2011), “Technical Guide and Protocols for Risk Reduction in Water and Sanitation Services.” SANAA (2004), Groundwater management in Honduras during the period 1988-2003, Aquifers vulnerability. PAHO/WHO (2001), Vulnerability assessment of the Comayagua Aquifer.	Establishes guidelines for incorporating vulnerability reduction criteria in WSS service management.
	Do workforce development plans in the WSS sector include opportunities for training in disaster risk management?			CONASA (2012), Training Plan for Municipal Water and Sanitation Commissions (COMAS), Module VII – Environmental Aspects in Service Management. SANAA (2011-2013), Climate Change and its Effects. SANAA (2014), Tegucigalpa Metropolitan Area. Training on Probabilistic Risk Assessment (CAPRA) to Strategic Planning Department and key stakeholders.	CAPRA in Tegucigalpa ongoing initiative supported by the World Bank.

a. http://www.siasar.org
b. http://www.ersaps.hn/documentos/interes/Guía%20y%20Protocolos%20Reducción%20Riesgos%20APS.pdf

	ELEMENT OF ANALYSIS	2013	2014	Source of Verification	Comments
RISK REDUCTION	Does the primary WSS service provider have a DRM unit or department?			SANAA, Strategic Investment and Projects Development Division. Disaster risk management has been considered a function of this division, which is responsible for planning at the national level. SANAA plans to establish a Technical Unit for DRM. SIPDD count with Risk Prevention Officers certified by COPECO, but no designated budget line to implement DRM activities. SANAA Regional Offices have develop contingency plans in liaison with COPECO.	The WSS sector needs a unit that oversees all phases of risk cycle. To date, the main focus has been on reconstruction and rehabilitation of WSS systems affected by events.
	Do the primary WSS service provider's operation and maintenance plans take into account aspects related to emergencies and risk management?			No plans have been developed.	
	Has funding been assigned for activities specifically related to DRM?			No line item exists within WSS service providers' budgets.	
	Have concrete actions to reduce vulnerability in WSS systems been either planned or undertaken?			Partial sectorization of the network in the WSS system serving Tegucigalpa. The three water sources that supply Tegucigalpa are redundant.	
	Have threat and risk evaluations been included in the construction of new infrastructure?			SEFIN, "General Methodological Guide for the Development and Evaluation of Public Investment Plans and Programs." SEFIN, "Sectoral Methodological Guide for the Development and Evaluation of Water and Sanitation Programs." ERSAPS (2012), "Technical Guide and Protocols for the Disaster Risk Reduction in the Management of Water and Sanitation Services."	
PREPAREDNESS	Does the WSS sector have emergency/contingency plans linked to national/local emergency plans?			SANAA (2009), "Contingency Plan for Conception and Laureles Reservoirs." SANAA (2011), "Operational Continuity Plan – Threat: epidemics/pandemics." SANAA, summer campaign in Tegucigalpa, 2012-2013. SANAA (2012), "Emergency Plan 2012."	Awareness of water use during drought.
	Have competent institutions been identified for WSS response, including an assessment of their respective strengths and capacities for response?			Baseline Report – Honduras (2012). Mapping of response capacities and preparation and response plan of the technical committee on water, sanitation, and hygiene (WASH) in emergencies.	Under the "Strengthening capacity and coordination of regional and national WASH clusters in disaster prone countries" project.
	Does the country have specific national coordination mechanisms for WSS institutions and actors?			Technical committee on water, sanitation, and hygiene (WASH) in emergencies, WASH Emergency Table.	Co-led by UNICEF, SANAA, Global Village Project, and Action Aid.
	Are tools and procedures available for damage assessment and needs analysis (DANA) of WSS systems?			WASH Emergency Table, Templates for Damage Assessment and Needs Analysis.	

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POLICY AND REGULATORY INSTRUMENTS	Do the disaster risk management and climate change legal frameworks consider the WSS sector?			Law 337, Creation of the National Disaster Prevention, Mitigation, and Response System (SINAPRED). The Nicaraguan Company of Water and Sewers (ENACAL) and the Nicaraguan Institute of Aqueducts and Sewers (INAA) represent the WSS sector under the SINAPRED framework.	
	What institution represents the WSS sector in national disaster risk management forums?			INAA and ENACAL participate in the SINAPRED as the representative of the WSS sector; however, the governing body of the WSS rural subsector (Nuevo FISE) and the municipal WSS companies (EMAPS) are not involved and do not receive feedback on these topics.	
	Does the WSS legal framework take into account disaster risk management and climate change adaptation considerations?			Decree No. 52-98, Regulations for the General Water and Sanitation Services Law.	Considerations limited to the preparation for and response to emergency and disaster situations.
	Are disaster risk management and climate change adaptation considered during planning processes in the WSS sector?			Nicaragua Association of Municipalities (AMUNIC), Strategic Integrated Water and Sanitation Plan – Alternative for the Water and Sanitation Sector in Local Government (2012).	
	Do national or sectoral planning instruments or the national public investment system norms take DRM and CCA into account in the planning, design, and construction of WSS services?			Law 337, Creation of the National Disaster Prevention, Mitigation, and Response System (SINAPRED). AMUNIC (2012), Nicaragua Association of Municipalities Strategic Integrated Water and Sanitation Plan – Alternative for the WSS Sector in Local Government.	
	Are WSS infrastructure and services explicitly identified as critical, essential, or vital services for disaster risk management?			WSS services are not explicitly recognized as essential or critical.	
DESIGN AND OPERATION CODES AND STANDARDS	Do design and construction codes and standards for WSS infrastructure incorporate DRM and CCA aspects?				
	Risk identification			INAA (1999), Technical standards for the design of water supply and treatment installations (NTON 09 003-99). INAA, Technical guidelines for the design of sewer and wastewater treatment systems.	Specific mention of the location of components and routing of the water distribution networks in order to avoid passing through areas at risk of landslides or floods.
	Risk reduction			Design Standards for Rural Water Supply and Basic Rural Sanitation.	
	Preparedness			Decree No. 52-98, Regulations for the General Water and Sanitation Services Law.	
	Financial protection				No evidence was found in the codes or standards analyzed.
	Resilient reconstruction				No evidence was found in the codes or standards analyzed.
	Are monitoring and control mechanisms in place to ensure compliance with standards?			Nicaraguan Institute of Aqueducts and Sewers (INAA).	

	ELEMENT OF ANALYSIS	2013	2014	Source of Verification	Comment
RISK IDENTIFICATION (Threat, Exposure, and Vulnerability)	Do WSS institutions have access to reliable and updated information about the risks present in the country?			Nicaraguan Institute for Territorial Studies (INETER).	
	Do WSS institutions have cadastral information systems and keep an updated registry of the location and characteristics of the main components of the WSS systems?			ENACAL has limited systematized cadastral information on cadasters Information System for Rural Water and Sanitation (SIASAR) – Nuevo FISE is gathering information on RWSS systems nationwide.	
	Do WSS institutions have mechanisms for monitoring the system to identify network and main components failures?			Not evaluated due to lack of access to relevant information	
	Have WSS institutions generated information on how events/emergencies have altered system functionality?			ENACAL (1998) – "Damage Report for Drinking Water and Sanitation (second report)" ENACAL (1998) – Rural Water Division – "The Water and Sanitation Sector Response to Hurricane Mitch"	
	Have studies been carried out on the risk or (functional) vulnerability in the WSS sector?			PAHO/WHO (2002), "Diagnostic of the situation of drinking water supply systems in the areas affected by hurricane Mitch."	
	Do workforce development plans in the WSS sector include opportunities for training in disaster risk management?			ENACAL, "2008-2012 Institutional Development Plan – Strategic sectoral proposal." Consider the need to make available the necessary resources and trained personnel for its implementation.	
RISK REDUCTION	Does the primary WSS service provider have a DRM unit or department?			Decree No. 53-2000, Regulations for Law 337, Creation of the National Disaster Prevention, Mitigation, and Response System.	
	Do the primary WSS service provider's operation and maintenance plans take into account aspects related to emergencies and risk management?			PAHO/WSO (2004), Manual for Drinking Water Supply Systems Maintenance to Reduce Operational Vulnerability.	
	Has funding been assigned for activities specifically related to DRM?			Not evaluated due to lack of access to relevant information.	
	Have concrete actions to reduce vulnerability in WSS systems been either planned or undertaken?			Decision to relocate the Managua Wastewater Treatment Plant. COSUDE (2011), "Guide to reduce vulnerability in drinking water and sanitation systems – Conceptual framework and instruments." PAHO/WHO (2002), "Technical guide to reduce vulnerability in drinking water and sanitation systems."	
	Have threat and risk evaluations been included in the construction of new infrastructure?			INAA (1999), Technical standards for the design of water supply and treatment installations (NTON 09 003-99). Technical guidelines for the design of sanitation and wastewater treatment systems (INAA). Design Standards for Rural Water Supply and Basic Rural Sanitation.	
PREPAREDNESS	Does the WSS sector have emergency/contingency plans linked to national/local emergency plans?			Preparation and Response Plan for Drinking Water, Sanitation, and Hygiene for Emergency and Disaster Situations in Nicaragua – Draft (2008).	
	Have competent institutions been identified for WSS response, including an assessment of their respective strengths and capacities for response?			Mapping of WSS sector actors and capacities.	
	Does the country have specific national coordination mechanisms for WSS institutions and actors?			The WSS sector is part of the SINAPRED Technical Sectoral Committee for Transportation and Infrastructure that is coordinated by the Ministry of Transportations and Infrastructure (MTI).	
	Are tools and procedures available for damage assessment and needs analysis (DANA) of WSS systems?			DANA forms for WSS developed by SINAPRED.	

a. http://www.siasar.org.

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POLICY AND REGULATORY INSTRUMENTS	Do the disaster risk management and climate change legal frameworks consider the WSS sector?			The National System for Civil Protection (SINAPROC) legal instruments—which covers the national, provincial, and municipal Civil Defense Departments—do not explicitly mention the participation of WSS sector.	
	What institution represents the WSS sector in national disaster risk management forums?			National Institute of Aqueducts and Sewers (IDAAN).	
	Does the WSS legal framework take into account disaster risk management and climate change adaptation considerations?			Decree Law No. 2 – Regulatory and institutional framework for the provisions of water and sanitation services.	
	Are disaster risk management and climate change adaptation considered during planning processes in the WSS sector?			National Institute of Aqueducts and Sewers (IDAAN), Strategic Plan 2012. Specific actions include the following: - Develop emergency response and preventive action plans for sewer systems, and support and supervision of the operation of treatment plants. - Design contingency plans for emergencies. - Identify and inventory the most vulnerable materials and equipment of the water and sanitation systems.	
	Do national or sectoral planning instruments or the national public investment system norms take DRM and CCA into account in the planning, design, and construction of WSS services?			IDAAN Strategic Plan 2012. Ministry of Economy and Finance (MEF) – Methodological Guide for the Inclusion of Disaster Risk Management in Public Investment Projects in Panama (2013).	
	Are WSS infrastructure and services explicitly identified as critical, essential, or vital services for disaster risk management?			WSS services are not explicitly mentioned.	
DESIGN AND OPERATION CODES AND STANDARDS	Do design and construction codes and standards for WSS infrastructure incorporate DRM and CCA aspects?				
	Risk identification			IDAAN, Technical standards for the approval of WSS system design.	
	Risk reduction			Decree Law No. 2 – Regulatory and institutional framework for the provisions of water and sanitation services. Article 71. Obligation to mitigate environmental impacts. WSS service providers that alter the environment in the course of their service delivery have the obligation to minimize negative impacts. To that effect, it is mandatory to present environmental studies and proposals prior to the development of new projects.	
	Preparedness			Decree Law No. 2 – Regulatory and institutional framework for the provisions of water and sanitation services. Article 72. Contingency plans and programs. Water and sanitation service providers must establish contingency plans and programs to prevent and control negative environmental impacts that result from service delivery.	
	Financial protection			No evidence was found in the codes or standards analyzed.	
	Resilient reconstruction			No evidence was found in the codes or standards analyzed.	
	Are monitoring and control mechanisms in place to ensure compliance with standards?			National Public Service Authority (ASEP)	

	ELEMENT OF ANALYSIS	2013	2014	Source of Verification	Comments
RISK IDENTIFICATION (Threat, Exposure, and Vulnerability)	Do WSS institutions have access to reliable and updated information about the risks present in the country?			National Environmental Authority (ANAM) and Electric Transmission Company S.A. (ETHESA).	
	Do WSS institutions have cadastral information systems and keep an updated registry of the location and characteristics of the main components of the WSS systems?			The primary systems that serve Panama City have detailed information. The Sub-Directorate for Water and Sanitation (DISAPAS) of the Ministry of Health (MINSA) is gathering data on RWSS systems nationwide using the Information System for Rural Water and Sanitation (SIASAR).	
	Do WSS institutions have mechanisms for monitoring the system to identify network and main components failures?			Not assessed due to lack of access to relevant information.	
	Have WSS institutions generated information on how events/emergencies have altered system functionality?			No evidence was found regarding this kind of evaluation.	
	Have studies been carried out on the risk or (functional) vulnerability in the WSS sector?			IDAAN conducted a study on the functional vulnerability of its primary water supply systems.	
	Do workforce development plans in the WSS sector include opportunities for training in disaster risk management?			No evidence was found about this type of training.	
RISK REDUCTION	Does the primary WSS service provider have a DRM unit or department?			After the "Purísima" storm event, IDAAN defined a responsible focal point for these issues, but there is not an official unit at IDAAN that handles these issues.	
	Do the primary WSS service provider's operation and maintenance plans take into account aspects related to emergencies and risk management?			Not assessed due to lack of access to relevant information.	
	Has funding been assigned for activities specifically related to DRM?			Not assessed due to lack of access to relevant information.	
	Have concrete actions to reduce vulnerability in WSS systems been either planned or undertaken?			IDAAN, Strategic Plan 2012. Specific actions include the following: - Develop emergency response and preventive action plans for sewer systems, and support and supervision of the operation of treatment plants. - Design contingency plans for emergencies.	
	Have threat and risk evaluations been included in the construction of new infrastructure?			MEF (2013), Methodological Guide for the Inclusion of Disaster Risk Management in Public Investment Projects in Panama. IDAAN, Technical standards for the approval of WSS system design.	
PREPAREDNESS	Does the WSS sector have emergency/contingency plans linked to national/local emergency plans?			IDAAN Crisis Plan.	
	Have competent institutions been identified for WSS response, including an assessment of their respective strengths and capacities for response?			No analysis of WSS actors and capacities has been carried out.	
	Does the country have specific national coordination mechanisms for WSS institutions and actors?			Sectoral coordination mechanisms for disaster preparation and response have not been established.	
	Are tools and procedures available for damage assessment and needs analysis (DANA) of WSS systems?			There is no DANA tool for WSS.	

a. http://www.siasar.org.

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