

WATER SECURITY AND CLIMATE CHANGE,

A COMPARATIVE STUDY OF THE RULE OF LAW
AND WATER MANAGEMENT, FROM THE GLOBAL
TO THE LOCAL PERSPECTIVE IN THE REGION OF LATIN
AMERICA AND THE CARIBBEAN



CATHALAC

Water Center for the Humid Tropics
of Latin America and the Caribbean

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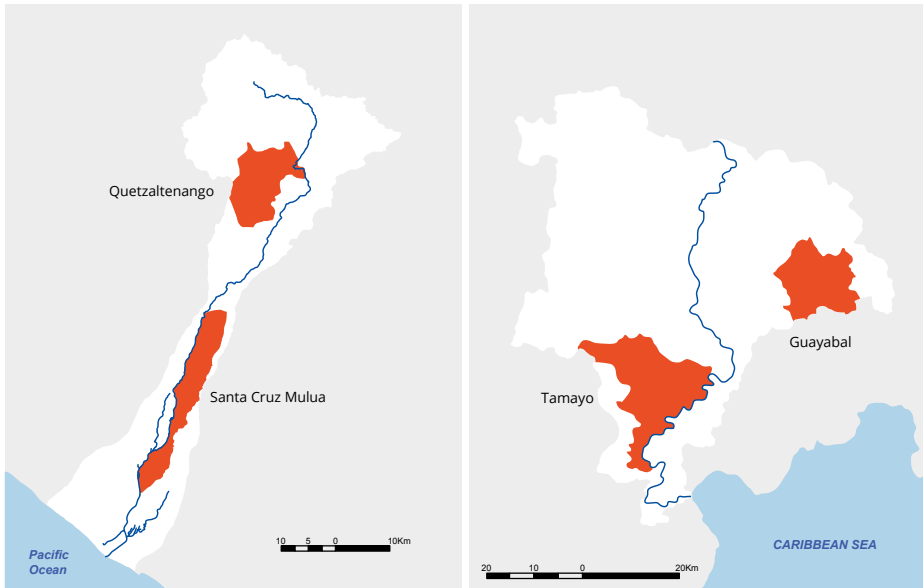
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Presentation



Between 2012 and 2015, with funding from the International Development Research Centre (IDRC, Canada), CATHALAC initiated a study on water security and climate change at the regional level, with attention focused on the political-institutional conditions of water management in the Dominican Republic and Guatemala. In both countries work was carried out hand in hand with the ministries of environment and two national universities, the Technological Institute of Santo Domingo (INTEC) and the University of San Carlos in Guatemala, respectively. Together with national partner institutions, the areas of focus were selected.

In the Caribbean nation, a study was made on climate change-related vulnerability in the Yaque del Sur watershed, as on the local water management in the municipalities of Guayabal and Tamayo. In Guatemala, the study focused on the Samala watershed and the municipalities of Quetzaltenango and Santa Cruz Mulua. In the four municipalities selected, located in the watersheds of this study, those responsible for municipal planning drafted municipal plans for adapting water resource management.

This work connects the water governance framework at the global, regional, national and local levels, and goes deeper into the concept of water security as a development policy, linking it to an adaptation measure for climate change; with which we expect to strengthen the recommendations that may arise from this exercise.



Dominican Republic National workshop



Guatemala National workshop

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CLIMATE CHANGE**
IN THE REGION OF
CENTRAL AMERICA & THE CARIBBEAN

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1. Summary

The results of evaluations regarding water governance, carried out within various contexts during the project Water Security and Climate Change in the Region of Central America and the Caribbean, contributed a wealth of information that was worth presenting in detail. The findings can provide water managers and other interested parties with lessons that lead to making better decisions, contributing towards the water security of our communities.

This work begins with an analysis of the concept proposal of water security and its contribution towards achieving development goals; it then goes into describing the relevant stakeholders, such as decision makers and technical advisors, from the international and regional context of Central America and the Caribbean. The analysis of the legal frameworks of the CARICOM and SICA countries (which covers up until October 2014) concludes that their public policies related to water and climate change favor the adoption of measures for water security, but that actions must be established as a function of goals and specific results. Also, the national governance maps revealed that the segmented functions related to the management of water resources lead to a lack of definition in terms of responsibilities, and interferes with an understanding of the contributions made by a program, an institution or a budget to water security in a given area. Gaps that exist in both countries that could limit the advancement of achievements were identified, including: the weak political relevance granted to water resource stewardship, lack of inspection and

monitoring, information systems that are not shared, and challenges in conflict resolution mechanisms, among others.

While in the Dominican Republic most of the responsibilities related to water management are centralized, in Guatemala the responsibilities delegated to the municipalities are broad, indicating that they have a greater degree of empowerment in this regard.

As regards local water security, it was possible to observe the gaps that exist within the water governance framework at the national level. Nonetheless, also at a local level, different and interesting solution-based approaches were found, built upon the opportunities that exist within each context. For example, elements that stood out were the contributions provided by grassroots organizations and local leadership, participative management and empowerment, training, public-private partnerships, project management capabilities and the contribution from international cooperation. These processes were supported by the participation of endogenous and exogenous actors.



Yaque del Sur, Dominican Republic



San Juan, Dominican Republic

2. Introduction

The countries in the region have been investing millions in the management of their water resources. Development indicators published by the World Bank show that in the past 12 years (2000-2012, which is the most current report for most¹), many countries have increased the coverage of their water and sanitation supply, in which Belize stands out in Central America and the Caribbean, with improvements greater than 20%. In contrast, other countries such as Haiti and the Dominican Republic reduced their performance, seemingly indicating that the capacity for expansion and growth of service providers is being overtaken by the demand.

1 For the year 2014, when the consultancy was performed.

Moreover, certain financial studies (Rodríguez, 2014) indicate for instance that Guatemala's central government invested, with its internal and external sources, 452 million US dollars in the period between 2005-2013 in water-related issues, mainly water and sanitation. In the Dominican Republic, on the other hand, more than 5 million US dollars were invested (Fundación Sur Futuro, 2014a).

Despite these numbers, we find that many of our cities and communities still suffer serious difficulties due to a lack of potable water services in homes, the pollution of water sources, water-related disasters, the displacement of access to historically utilized water sources, etc., and from the effects that these conditions have on health, education, access to development options, etc. For example, World Bank indicators show alarming levels of infant mortality in Haiti and Guatemala, with percentages between 30 and 75%. In other

countries, such as the Dominican Republic, Nicaragua, Honduras, and Trinidad and Tobago, percentages are above 20%. Moreover, comparisons between the coverage of improved sanitary installations and infant mortality seem to confirm the negative correlation between these two indicators, which others have also found².

It is not difficult to see that it is not only about the magnitude of investments in water, but also how they are implemented, so that they can have a more lasting impact on conditions in towns and villages. The last World Water Report (WWAP, 2015) reiterates the need to improve the conditions for water governance, as was indicated in the reports from 2006, 2009, and 2012; the document of the Americas presented at the IV World Forum in Mexico in 2006 also indicates that "the first priority for Latin America and the Caribbean is to improve

2 For example UNICEF (<http://www.unicef.org/spanish/mdg/childmortality.html>)

and consolidate water governance, with a change of paradigm for sustainable integration of water resources management and the use of these resources in socio-economic development and poverty reduction". This is a powerful call, but – what does it mean and how can it be achieved?

In recent years, UN-Water has promoted the concept of "water security", and defines it as "the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being³, 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"(UN Water, 2013). Understanding this concept as an end unto itself, the international community resolved⁴ that in order to move forward in terms of water security it is necessary to integrate water resource management (Planet Under Pressure, 2012).

3 Human wellbeing has multiple aspects, including the basic necessities for a good life, freedom of choice and action, health, good social relationships, and security (UN-Water, 2013).

4 United Nations Conference on Sustainable Development (Planet Under Pressure, 2012).

As if this was not enough of a challenge, climate change constitutes an additional factor with regard to water stress (Kundzewicz et al, 2007). The fifth report from the Intergovernmental Panel on Climate Change (IPCC) states that the risks that climate change represents for water resources increased significantly with the intensification of greenhouse gas emissions, with reduced amounts of renewable surface and underground water dry sub-tropical areas and a deterioration in water quality, among other effects (Cisneros et al, 2014).

On the other hand, the global quality of the climate change phenomenon has united humanity in the drive for decision-making: at a global level, for example, the United Nations General Assembly approved the agreements on Climate Change and the Combat Against Desertification and Drought, particularly the agreements reached by the Conference of the Parties held in Paris in December of 2015 (COP 21) regarding climate change; at a regional level, CARICOM and SICA have adopted policies and organized institutionalism; at the national level, the countries are launching legal and institutional structures, policies and plans that also translate into actions at the local level. This link is also reflected in technical and financial aid trends, channeled for example through the United Nations or bilaterally.

In parallel, municipalities that are or are not connected to international negotiations, to regional summits or strategies for climate change, or to the national adaptation plans, are developing – as they have always done - moderately successful responses to secure the water necessary to satisfy the basic needs of their citizens,

whether for productive, food or energy purposes, for transport and/or recreation; and also to learn how to live with the risks implied by the excess or lack of this liquid, responses that are now understood within the concept of water security. As Sadoff and Muller (2010) indicate, water security lies at the heart of adaptation to climate change.

The measures to promote and set in motion the actions towards water security are part of water governance and are set within the framework of the rule of law. The importance of the rule of law is that it establishes the scope of the rules of the game; it creates institutions and contains the ensemble of public policies that must be observed by all the stakeholders, public and private. On occasions, governability and governance are differentiated, in that the former highlights the political relationship between government and those that are governed by it, whereas governance defines the institutional structures through which public power is exercised and citizens participate in the decision-making process. However, in this document we use only the term water governance, which includes both meanings.

The United Nations defines the rule of law as a government principle according to which all persons, institutions and public and private entities, including the State itself, are subject to publicly proclaimed laws, which are implemented equally and applied independently, as well as being compatible with international human rights norms and principles (A/63/226, 2008). The rule of law is based on a founding text, commonly known as the constitution.

Public policies translated into laws, institutions, and budgets are

integrated into the rule of law; they reflect the degree of agreement reached by each society and, to that extent, apply various principles, including several that are relevant for water security and adaptation to climate change, such as the principles of equality, solidarity, efficiency, sustainability, participation, decentralization, and common but differentiated responsibilities (Colom, 2000; Peña and Solanes, 2003; Colom and Ballesteros, 2003).

Due to the extraordinary capacity of water to support all forms of life, its potential as a product input, and also its natural destructive power stemming from an excess or scarcity, the law considers water to be a public good. The law intervenes, regulating the relationship between people, society, the state and water, by organizing a special legal regime for its use and protection.

As part of water governance, two fundamental elements can be highlighted: decentralization and citizen participation. Decentralization consists of the process of delegating legal attributions, traditionally reserved for central and national public administration, to other levels, whether sectoral or territorial, public, private or social, including the participation of new stakeholders as users of water, the private sector, and the public itself. Decentralization can include many spheres, except those of regulation, monitoring and the implementation of justice. Citizen participation is key to transforming the relationship between society and water, because its methods and scopes must be expressly defined in the law to guarantee equal access to water, as well as compliance with the duties and obligations of protection and conservation in proportion to the direct benefits obtained from the

use of this good.

The measures in favor of water security are inserted in the rule of law, together with the other public policies that also contribute to the achievement of national development goals and objec-

tives. Likewise, they are inserted in global legal political considerations, among which we can highlight universal principles and values established in the United Nations Charter of 1945⁵; human rights systematized and introduced by the International Agreement

of Economic, Social, and Cultural Rights of 1966⁶; enhanced by the later inclusion of other rights, including the human right to water, integrated in 2010, as well as the International Agreement on Civil and Political Rights⁷.



The Río Samala watershed, Guatemala

6 Adopted and open to signature, ratification and accession by the General Assembly in its Resolution 2200 A (XXI), of December 16, 1966; in effect since January 3, 1976, in accordance with its article 27.

7 Approved and open to signature, ratification and accession by the General Assembly in its resolution 2200 A (XXI), of December 16, 1966; and went into effect on January 3, 1976, according to Article 27.



3. Objectives

General objective:

To look deeper into the concept of water security as a development policy and an adaptation measure for climate change, through the analysis of the water governance framework at the global, regional, national and local levels.

Specific objectives:

1. Analysis of the concept of water security as a development policy and an adaptation measure for climate change;
2. Establish a baseline for the framework of public, legal and institutional policies regarding water resources, decentralization and adaptation to climate change, observed by the member states of the Central American Integration System, SICA (from its acronym in Spanish), and the Caribbean Community, CARICOM;
3. Broaden the analysis of water governance and investments reported from national institutions in Guatemala and the Dominican Republic;
4. Evaluate the conditions of water security in four municipalities, connecting the results with the national governance framework and the local capacities for water management.



4. Analysis methodology

The current research was developed between 2012 and 2015. The study was both multidisciplinary (involving specialists in law, economy, engineering, geology, sociology, government employees, and members of community organizations, among others) and participative at various levels (regional, national, watershed, and local), moving beyond what was presented by Cook and Bakker (2012) when they stated that *"different disciplines have the tendency to focus on certain levels, which complicates or confuses the trans-disciplinary analysis of water security"*.

4.1. The concept of water security as a reference for water management

Through reviewing documents, talking with specialists in the region, meeting different stakeholders involved in water management at different levels and spaces – at the government, academic and private levels – the conceptual proposal of water security was revised along with its contribution to water management, as an adaptation measure to climate change and human development in general.

4.2. Analysis of the international and regional context

A review was based on aggregate, timely and reliable information of a formal nature, both binding (laws) and non-binding (statements), issued by the regional SICA and CARICOM groups, that could facilitate identification of substantive content and decision-making mechanisms related to the indicators and variables that led to the creation of a baseline proposal for the legal framework surrounding water security, adaptation to climate change, and decentralization.

4.3. Comparative analysis of legislation

A review of the public water and climate change policies established in the laws of the member states of CARICOM and SICA made it possible to identify the trends in legal regulations summarized in Table 1, identified from the analysis of the content of legal texts as well as the legal topics relevant to this study.

Table 1. Content of legal trends related to water in the member states of CARICOM and SICA

Water rights	Public water and sanitation services	Water conservation in watersheds	Risk management	Climate change
System of water rights for all users	Subsector water user	Water legislation	Attention to emergencies	Mitigation measures
Protection and recovery	Ruling entity	Soil legislation	Early warning system	Adaptation measures
Management of risks, shifts and divisions	Regulating entity	Forest legislation	Integrated risk management	
Water information and planning	Providers	Biodiversity legislation		Information and adaptation plans
Water authority	Users	Coordination and cooperation	Coordination networks	Coordination and cooperation

The analysis of legal texts containing public policies regarding water and climate change linked to water security was performed based on the review of close to 225 legal texts that form part of the rule of law of 15 CARICOM states and 7 SICA states, issued up to October, 2014. This information was inserted into a matrix organized around the indicators presented in Table 2, where the vertical axis shows the names of the countries and the horizontal axis shows the topics, comprised

of the 10 indicators and their variables.

The identification of these trends was also contrasted with the judicial doctrine and the compared legislation⁸, with the objective of sketching a proposal for a system of indicators to evaluate how the rule of law favors the adoption of measures for water security. The methodological proposal included 10 topics and 24 variables described in Table 2. The

first 8 topics refer to water rights, in other words, they regulate the waters situated within the territory of each country, over which they exercise total sovereignty and dominion, and include topics of watershed conservation, risk management and climate change; topic 9 refers specifically to public water and sanitation services; and topic 10 refers to international or transnational waters which are also governed by principles and regulations of international law.

⁸ Spota (1941); Dourojeanni and Jouravlev (2002); Peña and Solanes (2003); Colom and Balles-tero (2003); Caponera (2007); López (2007); Vapnek et al (2009); Salinas (2014); Embid and Martin (2015).

Table 2. Proposed indicators to evaluate the rule of law on water security

Topic/Indicator	Description	Variable
A. Geographic		A. Region
		B. Country
B. Legal		C. Document Title
		D. Number
		E. Date
		F. Source
		G. Law or policy
1. Water security, IWRM principles 0.999	Addresses principles; focuses on those promoted by IWRM that are compatible with sustainable development principles	1. Social Equity 0.333
		2. Economic efficiency 0.333
		3. Environmental sustainability 0.333
2. System of water rights and obligations 0.999	Refers to water rights, a central aspect of water governance, because it includes legitimate interests and expresses them in terms of rights and obligations, regardless of whether the holder is a public, collective or private entity.	4. Protection of ownership of water rights 0.333
		5. Beneficial and effective use 0.111
		6. Procedures, requirements and conditions for granting and transferring water rights 0.111
		7. Measures for conflict resolution 0.333
		8. Infringements and sanctions, administrative and judicial 0.111
3. Conservation 0.999	Distinguishes between the deterioration of water in watersheds and their protection from contamination caused by society	9. Deterioration 0.544
		10. Pollution control 0.455
4. Climate Change, Protection and Management 0.999	Specifically integrates adaptation to climate change and risk management, introducing the protection of fresh water ecosystems as an additional aspect	11. Freshwater ecosystem protection 0.333
		12. Risk management 0.333
		13. Adaptation to climate change 0.333
5. Hydrological Planning 0.999	Highlights the importance of water planning so that the development of water resources can deliberately contribute towards the fulfillment of national objectives, as well as including specific water security measures in plans that deal with climate change	14. National information system 0.333
		15. National Plan with water objectives and goals 0.333
		16. National Climate Change Plan with water-related objectives and goals 0.333
6. Participation and accountability 0.999	Highlights the importance of the participation of government institutions and their accountability to the public and water users.	17. The public and water users 0.999
7. Water Authority 0.999	Distinguishes whether water management corresponds to a specialized entity or is exercised by a user or environmental sector.	18. Specific 0.544
		19. Sectoral 0.455
8. Decentralization 0.999	Addresses decentralization, a fundamental aspect of integrating participation and adapting public policy plans, programs and projects to the particular conditions of the territory.	20. Watershed authority, local authority 0.999
9. Public Water and Sanitation Services 0.999	Integrates the regime of public water and sanitation services in order to satisfy a vital necessity; these services also represent a fundamental part of protecting the human right to water and sanitation; moreover, water use is subject to the legal regime of public services.	21. Ruling Entity 0.500
		22. Regulatory Entity 0.499
10. Transnational Cooperation 0.999	Indicates whether the countries have approved international conventions about international waterways and/or have signed bilateral agreements	23. Convention on the use of waterways for purposes other than navigation (Nueva York, 1997) 0.299
		24. Signed bilateral agreements 0.700

Each one of the main topics received the same weight of 0.999, which includes the 24 variables. A first exercise in comparison revealed a marked difference that did not favor island nations, where water supply is naturally critical. For this reason, a second evaluation was carried out adjusting the value of the

indicators as a function of the variables “Territorial extension” and “Total annual renewable water resources/km³”, data contained in Table 3. The weighted result of applying the indicators is shown in Table 5 of Results in the column “Adjusted Score”.

The conclusions of this research express a first impression that will have to be expanded upon for each country and integration system and contrasted with indicators related to the efficacy of application of each legal framework.

4.4. National governance framework

An analysis is presented of the results of several research studies on the respective legal frameworks – both institutional and those related to investments in adapting water resources to climate change – conducted by a multidisciplinary team: Elisa Colom (Colom, 2014), Radoslav Barzev (Barzev, 2014), Jeanette de Noack (Noack, 2014), María Leonor Rodríguez (Rodríguez, 2014) and the Fundación Sur Futuro technical team (Fundación Sur Futuro, 2014a,

2014b), the Center for Studies and Social Promotion (CEPROS, for its acronym in Spanish, 2015) of the Dominican Republic and the Association for the People’s Water (Asociación Pro Agua del Pueblo, 2015a, 2015b) of Guatemala.

The institutional analysis consisted in reviewing and analyzing documents and conducting interviews, taking into account the framework for water security that was simultaneously being

put together by the CATHALAC team (CATHALAC, 2015) and using the form from the water governance map that is presented below in Figure 3.

The economic analysis used the methodology proposed by the United Nations Development Program (UNDP, 2009) as a reference, however, the research team encountered methodology difficulties and it was decided to present general numbers.

4.5. Focus groups in the analyzed watersheds

As part of the participative approach, relevant stakeholders from the study watersheds created Focus Groups (FG) that met on several occasions in order to develop a portion of the theoretical and methodological aspects, complete research processes, discuss progress, strengthen individual and institutional capacities as well as interinstitutionality, and contribute towards the appropria-

tion of the recommendations related to water security and adaptation to climate change.

A balance was sought between the participation of members of civil society, the central government, local governments, academia, private enterprise and representatives from the municipalities prioritized for the pilot studies,

as well as the participation of women, young people and individuals without institutional representation who were nonetheless specialists or experts in topics related to the project, as well as members of executing institutions and their partners. Nonetheless, the participation of women was a challenge and it was not always possible to achieve an equal participation in proportion to men.

Table 3. General information about water in the CARICOM and SICA countries. Source: UNDP (2013)

	Country	Capital	Extension Km2	Total Population	Total Annual Renewable Water Resources km3	Water per capita m3 /yr	Extraction of fresh water as a % of renewable resources
1	Antigua and Barbuda	Saint John	443	92,436	0.05	584	3.3
2	Commonwealth of the Bahamas	Nassau	13,880	324,597	0.02	54	0
3	Barbados	Bridgetown	430	290,604	0.08	283	76.1
4	Belize	Belmopan	22,966	347,369	18.55	67,068	0.8
5	Commonwealth of Dominica	Rousseau	751	73,607	0	0	0
6	Grenada	Saint George	344	110,694	0.05	0	0
7	Co-operative Republic of Guyana	Georgetown	214,969	735,222	241	301,396	0.7
8	Republic of Haiti	Port-au-Prince	27,750	10,110,019	14.03	1,379	8.6
9	Jamaica	Kingston	10,991	2,950,210	9.4	3,396	6.2
10	Saint Kitts and Nevis	Basseterre	261	51,936	0.02	444	0
11	Saint Lucia	Castries	616	163,922	0	0	0
12	Saint Vincent and the Grenadines	Kingstown	389	102,627	0	0	0
13	Republic of Suriname	Paramaribo	163,820	579,633	122	185,206	0.5
14	Montserrat	Plymouth (Brades)	102	5,241	0	0	0
15	Republic of Trinidad and Tobago	Port of Spain	5,128	1,222,363	3.84	2,872	6
16	Guatemala	Guatemala City	108,889	14,918,999	111.3	8,480	2.6
17	El Salvador	San Salvador	21,041	6,141,350	25.23	4,172	5.5
18	Honduras	Tegucigalpa	112,090	8,746,673	95.93	11,613	1.2
19	Nicaragua	Managua	130,370	5,907,881	196.6	27,453	0.7
20	Costa Rica	San Jose	51,100	4,814,144	112.4	23,517	2.4
21	Panama	Panama City	75,420	3,657,124	148	36,639	0.3
22	Dominican Republic	Santo Domingo	48,670	10,478,756	21	2,043	16.6

4.6. Municipal water security, water management and design of adaptation measures

The evaluation of water security was carried out at the municipal level. To this end, the concept of water security was divided into elements that were analyzed through the indicators that appear in Table 4. The evaluation was integrated from multiple sources, first using semi-structured interviews performed at households from (396) the Yaque del Sur River watershed in the Dominican Republic, by the research team from the Santo

Domingo Technological Institute (INTEC, for its acronym in Spanish) (Contreras et al, 2015), as well as 1,519 interviews in the Samala River watershed in Guatemala, performed by the team from the Western University Center of the University of San Carlos (USAC, for its acronym in Spanish) (Alvarado et al, 2014).

The analysis was complemented with secondary references, the

reports from the aforementioned national consultancies, as well as interviews of administrative officials, including three of the four mayors.

The results were systematized and qualified on a scale of 1 to 3, where (1) corresponded to non-satisfactory performance, (2) average performance, and (3) satisfactory performance, from which summary graphs were made..

Table 4. Indicators of water security in municipalities

#	Water security element	Evaluation indicators
1.	Water availability and water sources	▶ Water availability ▶ Degree of pollution and degradation of water sources ▶ Forest cover ▶ Land use management plans/watershed management ordinances
2.	Water and development	▶ Relevance of water resources to the economy ▶ Water-use technologies and savings on main uses
3.	Services	▶ Access to improved water sources ▶ Quality of water for consumption ▶ Accessible water prices ▶ Access to improved sanitation infrastructure ▶ Solid waste management and disposal ▶ Hazardous and hospital waste management ▶ Access to improved water sources
4.	Health	▶ Incidence of parasite infections and diarrhea ▶ Incidence of dengue and malaria
5.	Food security	▶ Incidence of malnutrition, anemia, low birth weight or stunting in children under 5 years old ▶ Local food production
6.	Energy security	▶ Access to electricity ▶ Local availability of energy sources
7.	Risks	▶ Flooding risks ▶ Drought risks ▶ Landslide risks ▶ Hurricane risks (for the Dominican Republic)/ frost (for Guatemala) ▶ Community disaster response organization ▶ Accessibility in the rainy season and communications ▶ Migration caused by hydrometeorological risks
8.	Governance	▶ Legal security over water rights ▶ Municipal participation in water management ▶ Forums for cooperation and participation ▶ Transparency and availability of information ▶ Water-related litigation

4.7. Design of adaptation measures

After analyzing the results with regard to water security, issues were prioritized in municipal workshops using the “Multiple Criteria Analysis” technique with participants. In this way, each municipality selected the topics of interest to them. Afterwards, through work groups, an evaluation was made of municipal capacities to address the prioritized water security elements, that is, their strengths and weaknesses in terms of: (i) competencies and available legal instruments, (ii) municipal structure and available personnel; (iii) financing; (iv) established procedures; (v) equipment

and materials; (vi) information for decision-making; (vii) institutional alliances and stakeholder participation; (viii) technical knowledge in the management of projects related to the issue and experience in the implementation of solutions.

The identification of adaptation measures was carried out using the PSR (Pressure – State – Response) model. This technique makes it possible to analyze cause and effect for a specific aspect of water security. The “State” refers to the results obtained from the evaluation of municipal water security;

the “Pressures” correspond to external factors – i.e., the results of the evaluation of the national governance framework – as well as internal factors – i.e., the evaluation of municipal capacities for water management. The adaptation measures were identified as those actions that were necessary to change weaknesses in the “State” and in the “Pressures”, based on the framework created by CATHALAC (CATHALAC, 2015). The suggested adaptation measures became the municipal adaptation plans and are presented in detail in Annex 2.



5. Results

5.1. Water security and water management

In the Ministerial Declaration of The Hague on Water Security in the 21st Century⁹, the following was established in the year 2000 as a common goal: “To provide water security in the 21st century”. The Declaration explains that this means: “ensuring that fresh water, coastal and associated ecosystems are protected and improved; that sustainable development and political stability are promoted; that every person has access to sufficient potable water at a reasonable price to be able to lead a healthy and productive life; and that the most vulnerable populations are protected from the risks and dangers associated with water”. Further on, it adds: “the actions promoted here are based on an Integrated Water Resources Management. It is worth mentioning that for this event, GWP prepared the document Towards water security: a framework for action (GWP, 2000), which states that “the philosophy underlying the translation of the vision into action is Integrated Water Resources Management (IWRM) (p. 14). It is striking that practically from its beginning, the concept of water security has been linked to IWRM, at least at this level of relevance. The latter concept will be discussed further on.

Among other institutions that promote the concept of water security are: the Global Water Partnership (GWP, 2000, 2012), the Organization for Economic Cooperation and Development (OECD, 2013), and the United Nations (UN-Water, 2013). Their definitions are presented below:

GWP in Towards Water Security: A Framework for Action (2000) establishes that: water security means that at any level, from domestic to global, each person should have sufficient access to drinking water at a reasonable price to lead a clean, healthy and productive life, while at the same time guaranteeing that the natural environment is protected and improved. Those that use or share rivers, watersheds, and aquifers should manage the water in a sustainable manner, maintaining the balance for human development with the protection of the vital ecosystems and ecological services they provide (p. 12).

Later on, Sadoff and Muller (2009), from the same institution, expanded upon the concept: water security is defined as the reliable provision of an amount and quality of water that is sufficient for health, the production

of goods and services and the means of subsistence, together with an acceptable level of risks related to water, in a minimum but realistic base (p. 12).

OECD (2013) in its publication Water security for a better life states: Achieving water security means maintaining acceptable levels of the four types of risks associated with water:

- ▶ Scarcity (including drought): the lack of sufficient water to satisfy the demand (both short and long term) for beneficial uses by all water users (homes, companies and the environment);
- ▶ Inadequate quality: the lack of water of an adequate quality for a given purpose or use;
- ▶ Excess (including floods): overflowing of water systems (natural or constructed), or the destructive accumulation of water in areas that normally do not remain flooded;
- ▶ Affecting the resilience [or capacity for recovery] of fresh water systems: going beyond the capacity of superficial and underground water and their interactions; going beyond their thresholds and causing irreversible damages in the hydraulic and biological functions of the system (p. 2).

9 http://www.worldwatercouncil.org/file-admin/world_water_council/documents/world_water_forum_2/The_Hague_Declaration.pdf

UN-Water (2013), in the policy summary Water Security and the Global Water Agenda, establishes that water security refers to: "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" (p. 1).

Although there are other definitions, here we apply the concept of water security proposed by UN-Water, which was then taken up by others (WWAP, 2014 & 2015). This definition is valuable for several reasons: a) it talks about different elements related to water management, b) it emphasizes the need for the population to acquire capacities, c) it talks about a population, not necessarily a nation; that is, it can be attained at the local level, d) it links biophysical aspects with social ones or with water availability and use, e) it integrates the concept of risks, f) it refers to different competing water uses, g) it highlights the importance of maintaining peace and political stability.

The concept of water security is part of human security, which, based on the United Nations Charter of 1945, is recreated by the UNDP in the 1994 Human

Development Report¹⁰; currently it is associated directly with food security and energy security, a connection which is highlighted in all UNESCO reports about the state of water resources in the world. In this regard, UN-Water (2013) highlights:

- The status of water security, which is increasingly precarious, is beginning to affect food and energy systems at the global level, and the highest impacts are centered in the poorest and most vulnerable areas of the world;
- Water, food, and energy are intrinsically connected to security aspects and form a nexus to understand and address development challenges;
- By adopting holistic approaches regarding water, energy and food security, it is possible to reduce potential tension and conflicts.

¹⁰ Human security is presented as a new paradigm based on the 1945 United Nations Charter, defined as sustainable human Development, where economic growth is centered around human beings and is sustainable from one generation to the next (UNDP, 1994). It is built and complemented by an ensemble of initiatives in the International Pact on Social, Economic, and Cultural Rights, Agenda 21, Millenium Objectives in 2000, and now the SDG. Human security adopts an integrated, multi-sectoral, pertinent and preventive approach, which places people at the center of United Nations global initiatives; it includes all aspects of Development. Human security refers to liberating each person as a member of humanity, from lack of freedom; from material misery derived from a lack of opportunities, and discrimination and exclusion, so they can exercise their human rights. It is about offering security for everybody's daily needs, with a preventive approach and participation from the base of society, a security whose achievements and delays affect all humanity. Human security assigns the maximum priority to reducing poverty and promoting productive employment, social integration and the regeneration of the environment. It establishes a balance between the number of human beings, on the one hand, and on the other, societies' capacity for absorption and nature's capacity to provide sustenance; it attempts to accelerate economic growth, translated into improvements for human life, without destroying the natural capital necessary to protect the opportunities for future generations. This transforms the concept of international cooperation.

Water security reflects the degree of success that a specific population has with regards to water security. This is not incompatible with what other authors have proposed when associating the concept of individual experience; for example, Chocieł (2012) analyzes water security from the perspective of "guaranteed access to drinking water", and the legal implications that arise from the concept of the human right to water.

As it can be observed in the methodology, aspects related to health, nutrition and schooling were included within the selected indicators to measure water security in municipalities; these elements can tell us about the living conditions of the population and are related to adequate access to water.

During the course of this study, the need to evaluate water security for each specific case was confirmed: for example, municipalities did not prioritize all aspects of water security in the same manner, nor did they decide to address all of them in an adaptation plan, given that the municipalities had different problems and levels of advancement in the different issues, as well as different degrees of institutional maturity, capabilities and opportunities to deal with all of the issues from the beginning. This suggested not weighting the indicators or the factors that were evaluated with regard to municipal water security. On the other hand, in the comparative analysis of legislation between countries in Central America and the Caribbean, it was necessary to use an adjustment factor for the small Caribbean islands in order to highlight differences, in this case, related to their size and water availability.

As suggested by van Beek and Lincklaen (2014), the concept of water security lends itself to comparisons, and we agreed on the possibility of having a “global objective” as suggested by UN-Water (2014), since the concept helps to achieve development goals (as stated at the Water Summit in Budapest in 2013: “A Sustainable World is a World with Water Security”), directing governmental actions towards an integrated goal and thus being able to go from an a situation in water security to a b situation. Nonetheless, it is necessary to pay attention to the weighting of variables to accurately judge different levels of performance. In any case, it is preferable to find adequate levels of water security for each population, through goals built in a participative manner and at the local level as close as possible to the population, to avoid the generalized use of global indices that hide inequalities (Quiroga, 2007) or devalue individual experiences (Chocie, 2012).

The concept also provides the possibility of harmonizing sectoral policies towards a single vision, which makes it possible to break away from the historical tendency of managing water in sectors. This is the recent case (2015) of Panama, when a High Level Commission from the President's Office gathered different sectoral stakeholders to develop a National Water Security Plan¹¹, highlighting another virtue of this concept, which is its capacity to attract political interest, so necessary and oftentimes insufficient to elevate the relevance of the issue in Government agendas, and therefore in budgetary allocations.

Cook and Bakker (2012) state that water security is a framework

11 <https://www.presidencia.gob.pa/Noticias/Gobierno-enfrentara-impactos-del-Fenomeno-del-Nino-y-crea-Comision-de-Seguridad-Hidrica>

that offers a vision, a final goal or particular state, whereas the IWRM approach focuses its attention on the process. We believe they are complimentary proposals, where IWRM would be the natural mechanism (process) to achieve water security (the goal); in fact, that is how it is presented in the Declaration of The Hague¹².

IWRM is a proposal presented globally by several intergovernmental entities, such as GWP, and multilateral organizations such as UNESCO, UNEP and other UN agencies motivated to establish an alternative to a foreseeable world crisis of fresh water scarcity, marked by demographic and economic growth, poverty, overuse and pollution.

GWP proposes that IWRM “is a process that promotes the coordinated management and development of water, soil and related resources, in order to maximize the resultant social and economic wellbeing in an equitable manner without compromising the sustainability of vital ecosystems” (GWP, 2000)¹³; it recommends basing this focus on the Dublin Principles¹⁴, and it expressly states that “the IWRM practices depend on the context”, an approach that considers the need to achieve good water governance by overcoming the sectoral, uncoordi-

12 The concept of IWRM was being posed in the World Water Forums held in Marrakesh, Morocco, 1997, The Hague, Netherlands, 2000, and Kyoto, Japan, 2003, and its validity was ratified in the following forums up to Daegu, Korea in 2015.

13 GWP embodies IWRM's initial proposal in the year 2000, in Technical document No. 4 called Integrated Water Resources Management, which can be read on the institutional website www.gwpforum.org; and also offers an online toolbox with IWRM experiences around the World, organized into three main groups: facilitator environment, institutional roles, and management instruments; embodied in 59 tools that can be accessed at <http://www.gwp.org/en/ToolBox/ABOUT/What-is-ToolBox/>

14 We recommend reading the Dublin Conference Declaration and Action Plan as well as document Tec 4 from GWP, to understand the context in which these principles were adopted and then considered.

nated and fragmented approaches that currently characterize water management, along with a disconnection between the government and the public.

It should be noted that the Fourth Evaluation Report from IPCC, in its chapter on water resources (Kundzewicz et al, 2007), states that “the sustainable management of water resources has gained importance at the regional and global level, and Integrated Water Resources Management has become the corresponding scientific paradigm.” However, in the Fifth Report published in 2014 there is no further mention of this concept.

Nonetheless, IWRM is once again considered by the United Nations General Assembly¹⁵ as part of the global proposal to guide the development of nations during the next five years. The agenda titled Transforming our world: the 2030 Agenda for Sustainable Development, with 17 sustainable development goals (SDG) and 159 objectives, went into effect on January 1st, 2016 (see Box 1).

Also published in 2015, the United Nations World Water Development Report (WWDR, 2015) takes up once again the concept of IWRM, although it criticizes the fact that the approach has been more oriented towards economic efficiency than towards equity, environmental sustainability and the adaptation of measures to strengthen social, administrative, and political responsibility, and places them as pending tasks. WGF (2012) has also complained, saying that this approach has a tendency to exclude groups with less power, not only from access to water

15 Draft resolution A/69/L85 from August 12th, 2015, approved by the United Nations General Assembly held on September 25th, 2015, in New York City.

resources, but also from the processes through which decisions are made regarding their allocation, and suggests instead a human rights-based approach (HRBA), where the rights, rules, standards and principles of the international human rights system are incorporated into plans, policies and development processes¹⁶.

Box 1. Sustainable Development Goals and Water Management

The SDGs clearly expand and improve the considerations regarding water that were presented by the Millennium Development Goals (MDGs), which regarded drinking water and sanitation as part of the environment. Currently water is granted its own identity by including a specific goal with broad and holistic objectives:

Goal 6 on the Agenda refers to: “Guaranteeing availability and sustainable management of water and sanitation for everyone”, establishing goals that are understood to be part of a whole, as follows:

- 6.1 For 2030, achieve universal and equal access to drinking water, at an accessible price for all;
- 6.2 For 2030, achieve equal access to sanitation services and adequate hygiene for all, and put an end to open air defecation, paying special attention to the needs of women and girls, and persons in vulnerable situations;
- 6.3 For 2030, improve water quality by reducing pollution, eliminating dumping, reducing the disposal of dangerous materials and chemical products to a minimum, reducing the percentage of untreated waste-waters by half, and substantially increasing recycling and reutilization in secure conditions at the global level;
- 6.4 For 2030, substantially increase the efficient use of water resources in all sectors and ensure sustainable extraction and provision of fresh water to address water scarcity and substantially reduce the number of people that suffer from lack of water;
- 6.5 For 2030, put integrated water resources management into practice at all levels, even through transnational cooperation, as may be necessary;
- 6.6 For 2020, protect and re-establish water-related ecosystems, including forests, mountains, wetlands, rivers, aquifers and lakes;
- 6.7 For 2030, increase international cooperation and support to developing countries to create capacities in water- and sanitation-related activities and programs, including water harvesting and storage, desalinization, efficient use of water resources, treatment of wastewater, and recycling and reutilization technologies;
- 6.8 Contribute towards and strengthen the participation of local communities in the improvement of water and sanitation management.

¹⁶ Human rights-based approaches support the idea that people have the right to actively participate in development, and they are not considered to have only needs, but rather legal rights, so that they are not objects of charity or passive beneficiaries, but rather active participants in the development process (it also explains that the rights include the responsibility of respecting the rights of others) (WGF, 2012). The same quote explains that the HRBA identifies substantial rights (such as the right to life, food and housing), and procedural rights (like the right to information, the right to participate, and the right to legal compensation).

Indeed, the application of an IWRM approach has not been - and is not - a simple task, as it refers to a relationship between a natural system and a social system, both of which are dynamic in nature and require immediate actions, while the results are seen in the medium to long term. The reality is that the multi-dimensional character of water resources provides many possibilities for integration:

integrating water as an element of nature and as a production resource; the amount and quality of water; supply and demand; the management conditions for the upper and lower parts of a watershed; the soil resource in conjunction with the water resource; surface water and underground water; management approaches and top-down and bottom-up decision making; consumptive,

non-consumptive and traditional uses; risk and emergency management with vulnerability/adaptation to climate change; local human development and national development; the human right to water and economic efficiency; rural watersheds, urban watersheds and coastal zones; rain water and waste water; etc. The GWP suggests that the practical implementation of the approaches derived from common

principles – such as an IWRM – should reflect the variations in local conditions, therefore taking different forms. Nonetheless, each one of the alternatives has implications that must be understood in a specific context and timeframe if concrete impacts are to be obtained with limited time, money and staff resources. Occasionally, initiatives that are supposedly framed under the IWRM paradigm propose commendable measures which are nonetheless out of touch with the reality, conditions or capabilities of the actors in charge of executing them; and what is most dangerous is that oftentimes they are not directed towards solving the water problem, but rather towards attempting to establish a form of management. This situation is regrettable, especially with regard to maintaining credibility with decision-makers and political stakeholders, given that in itself, establishing an “integrated water management” system does little to solve the problem, and the initiatives are difficult to justify, to insert within a budget and to have their impacts measured, assuming there are any.

On the other hand, it is worth stating that although water governance does not have the ability to correct structural problems within global, regional, national or local society, it would have the power, in the first place, to highlight situations that reveal humanitarian imbalances, such as the lack of access to water and sanitation services, the lack of food, malnutrition, poverty, environmental deterioration, and the impacts caused by extreme hydroclimatological events that cause loss of lives and destroy infrastructures; at the same time, it should not replicate these imbalances in the processes that are promoted. Already, Tremblay (2011) has warned against imposing less optimal foreign water

management models to specific conditions, and Moench et al (2003) warns about not settling for an “expert” vision that is disconnected from the reality experienced by the community. And without making light of systematized knowledge, in a democratic and participative process, when choosing an alternative solution or work approach, the consequences of uncertainties will be assumed, trying to fairly distribute the benefits and costs of those decisions.

Nonetheless, during the course of the study carried out by CATHALAC, a space was found for evaluating the municipal and national management of the pilot cases through a concrete reference that was able to overcome the criticisms mentioned above. To this effect,

an extensive bibliographic review was begun, and, together with contributions from colleagues on the research team and local stakeholders from the Focus Groups, a framework began to take shape that was published as Water Management for Water Security in the face of Climate Change (CATHALAC, 2015). In general, it was concluded that in order to achieve water security¹⁷ it is necessary to have joint management by several institutions (sectoral and non-sectoral) and society; that by strengthening their capabilities (for planning, financing, administration and information), they can ensure the provision of water and the protection of its sources, in order to satisfy needs equitably and in

¹⁷ Defined in the terms suggested by UN-Water (2013).

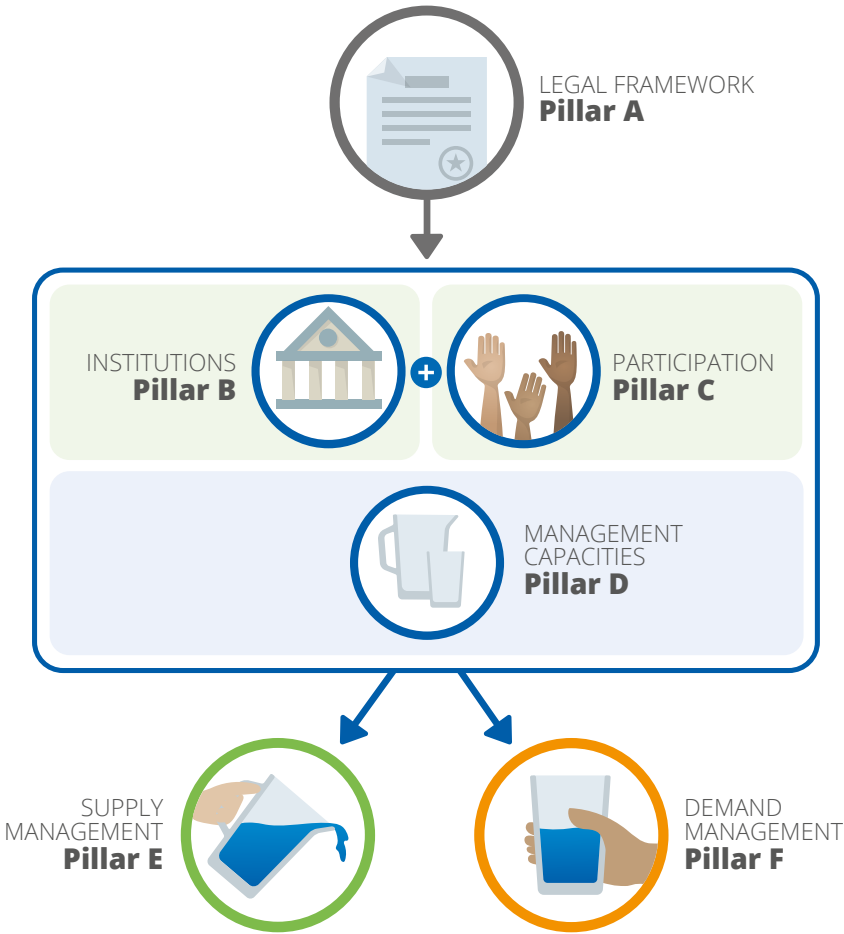


Figure 1. Framework for water management for water security in the face of climate change (CATHALAC, 2015).

an orderly and efficient manner, within the framework of legislation that considers sustainability principles (Figure 1).

This concept points towards integrating basically three dimensions:

- A first level of integration takes place within each water use sector, when contemplating aspects such as supply and demand management and strengthening of institutional capacities during the development of investment plans (pillars D, E and F in Figure 2).

- **Pillar E:** Supply management consists, on the one hand, of protecting sources and managing the watershed, and on the other, of having the necessary infrastructure to deliver the water to the final user, including operations, maintenance and replacement.

- **Pillar F:** Demand management looks at user behavior, and serves to:

- e) Control and organize the increase in water use,
 - f) Increase efficiency,
 - g) Reduce pollution, and
 - h) Avoid conflicts.

Demand management depends on educational tools, regulation and monitoring, economic tools, coordination, participation and conflict-resolution tools.

- **Pillar D:** Water management capacities are related to basic management elements: planning, financing, human resources, contracts and bids, hydrological monitoring, and information systems maintenance.

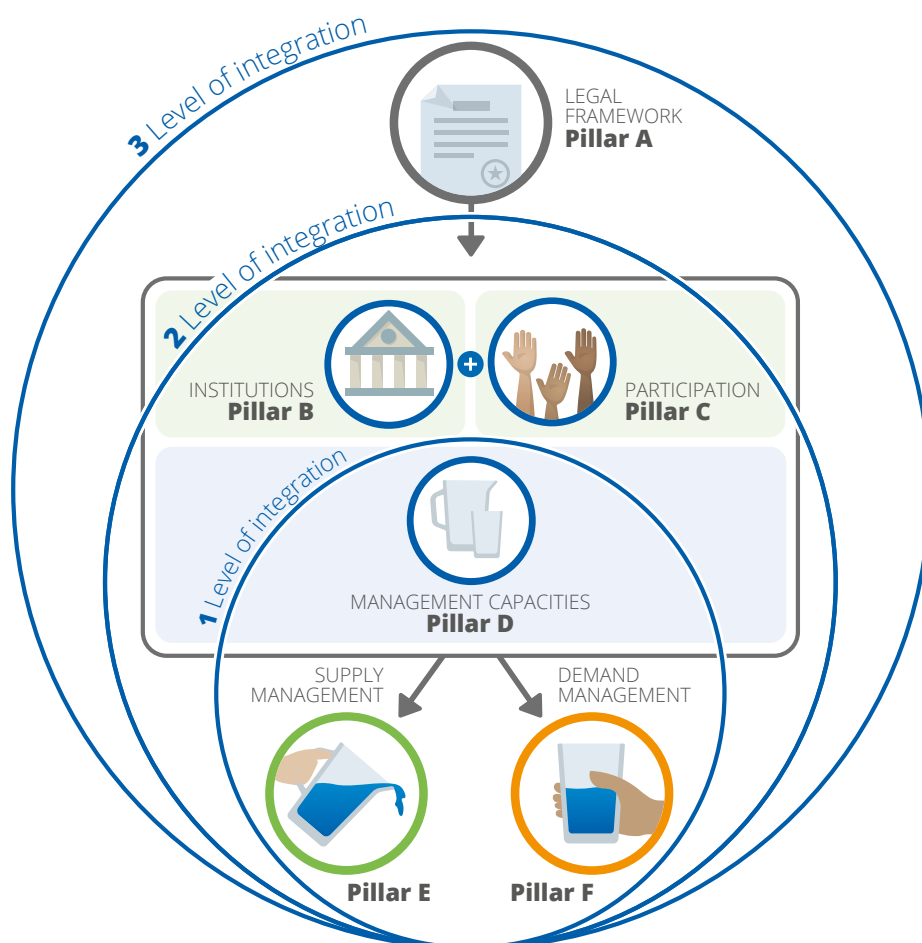


Figure 2. Levels of water management integration

- A second level of integration consists of integrating the harmonious development of each sectoral water user into joint management or water security plans. As with the previous aspect, society's participation is fundamental (Pillars B and C in Figure 2).

As we can see in Figure 3, to move towards water security it is necessary to have the participation of multiple stakeholders who fulfill specific functions within water management, for example, a) institutions that develop infrastructures or intervene in watersheds and sources; b) institutions that support decision making, such as research centers, universities and specialized universities and institutes that conduct monitoring and scientific observation; c) institutions in charge of bringing the water to the users (public, private or mixed) and service regulating institutions; d) institutions that promote social participation, such as the media, NGOs, or other spaces; e) and finally, the institutions in charge of water planning and management.

Figure 3. To move forward in water security it is necessary to have the participation of diverse coordinated stakeholders

	FUNCTION	MAJOR USES							
Governance	Policies, regulations								
	Planning								
	CC Adaptation								
	Conflict Resolution								
Social Incidence	Monitoring, Supervision and Sanctions								
	Communication and Education								
	Spaces for Participation and Dialogue								
Services	Service Provider								
	Service Regulator								
Decision-making support	Hydrologic monitoring and information systems								
	Research								
	Technical advice and training								
Intervention	Water source conservation and protection								
	Infrastructure								

► A third level of integration is to consider water security as a government goal with the participation of the different branches, and to make it part of public and budgetary agendas, not only in the short term, but also for the medium and long term. Generally it will be the responsibility of the executive branch to develop and implement plans for water resources, however, the assemblies as well as the courts have unavoidable powers regarding water management: the former are ideal discussion spaces and are charged with government institutional

design as well as establishing both the players and the rules of the game; on the other hand, the courts and tribunals must guarantee with impartiality and autonomy the fulfillment of the Law or Rule of Law, ensuring effective, fair and solidary conflict resolution mechanisms.

Embid and Martin (2015), upon reviewing the evolution of laws in Latin America, recognize that it is “naïve to think that the solution to the complex structural problems that determine the multiple economic, social, political and environmental aspects of water

management can be achieved exclusively through the adoption of a new legal text”, but at the same time they show how a law can play a decisive role in a specific context, becoming a cause and consequence of change. In other words, adopting water security as the goal in water management, and IWRM as the means to re-create the process, highlights the need to establish within the rule of law public policies that ensure substantive, organizational and procedural measures to achieve specific goals and objectives that respond to societal desires.

5.2. The international and regional context in terms of climate change and adaptation

In the realm of water security and adaptation to climate change, stakeholders participate at the global, continental, regional, national and local level, given that the temporal and spatial scarcity or excess of water and the impacts of climate change are global phenomena with local impacts. These are public and social stakeholders with diverse characteristics; some act at the political level whereas others do so at the socio-economic level; some are scientists, advisors and scholars, whereas others lobby for public, collective, and individual interests and rights; some organize to provide technical assistance, and still others to provide financial aid.

5.2.1. Political aspect

At the global level, political leadership is carried by the United Nations General Assembly (UNGA); on this continent, by the Assembly of the Organization of American States (OAS); at the regional level by CARICOM and SICA, and by the

meeting of presidents, heads of state or prime ministers; at the national level, by the legislative assemblies and heads of state or prime ministers gathered in a government cabinet; and at the local level, by municipal authorities, development councils and watershed authorities, as the case may be.

The global actors have synergies between the UN, the Conferences of the Parties (COPs) to the various international agreements, and the specialized agencies of the United Nations System (UNS). Particularly relevant are the decisions of the COP at the United Nations Framework Convention on Climate Change (UNFCCC), at the United Nations Convention on the Battle against Desertification, of which all of the CARICOM and SICA countries are members; and the United Nations Convention on the Use of International Waterways for Purposes Other than Navigation, which, though not approved by any of the countries of the American continent, is the world reference

for this topic.¹⁸

At the regional level, the SICA integration system is the most influential political authority; the current agenda of the Meeting of Presidents specifically includes the topic of climate change and IWRM as part of the environmental strategy. Even though it is legitimized to act and grant importance and interest to the issues addressed, its scope of influence is limited, as well as its resources. The synergy between SICA and the countries is identified in the topic of risk management; actions are focused on the adoption of regional policy measures without yet having the institutional and financial regional mechanisms to set these decisions in motion, but the Regional Water Resources Committee (CRRH, for its acronym in Spanish) is maintained as the regional organization for technical research on water and climate change.

¹⁸ In accordance with the control of approvals carried out by the legal office of the United Nations thru November 30th, 2015.

On the other hand, the community of CARICOM countries is without a doubt the most important political entity in the Caribbean; it has political influence, is legitimized to act, and has assigned importance to the topics of water and climate change, although weighted against topics of development in general. Jointly, CARICOM, its community institutions and countries, have positioned the issue of climate change as a part of sustainable development, creating specialized regional agencies and developing numerous planning tools which have had follow-up.

5.2.2. Technical aspect and institutional mechanisms

The technical-scientific aspects of climate change are generally addressed by specialized UN agencies such as UNESCO and WMO and by specialized organizations such as IPCC, with synergy and communication being particularly evident between IPCC and UNFCCC; in the American continent, by organizations such as the Pan-American Health Organization (PAHO), the Inter-American Institute for Cooperation on Agriculture (IICA), and the Economic Commission for Latin America (ECLAC); as well as intergovernmental organizations, where CATHALAC comes in.

In the region, the SICA and CARICOM integration systems have created their consulting departments through various institutional mechanisms. From its beginning (the Treaty of Chaguaramas of 1973 that created the community

of interests), CARICOM incorporated the Caribbean Meteorological Institute (CMI) and the Caribbean Meteorological Organization (CMO) as specialized organizations; later came the Caribbean Disaster Emergency Management Agency (CDEMA), previously known as the Caribbean Disaster Emergency Response Agency (CDERA); and since the year 2002, the Caribbean Community Climate Change Centre (CCCCC) has been in operation. CARICOM adopted the Regional Framework for Achieving Development Resilient to Climate Change (2009 – 2015) and its action plan, a policy approved by the heads of state in 2009 and which is also part of the global SIDS initiative, mentioned in the Barbados Programme of Action, the Mauritius Strategy of Implementation, and the Samoa Pathway of 2014.

SICA, on the other hand, is organized as per the Tegucigalpa Protocol. Among its institutional mechanisms are the Regional Water Resources Committee (CRRH, for its acronym in Spanish) and the Central American Coordination Center for Natural Disaster Prevention (CEPRENAC, for its acronym in Spanish). In 1993 it adopted the Regional Convention on Climate Change; in 1999, the Strategic Framework for the Reduction of Vulnerabilities and Natural Disasters in Central America; the Mesoamerican Initiative for the Prevention and Mitigation of Natural Disasters in 2001; the Strategic Framework to confront the situation of food and nutritional insecurity associated with the conditions of drought and climate change in 2002;

the Guidelines for the Regional Strategy on Climate Change of 2008; the Central American Policy for Comprehensive Disaster Risk Management of 2010; and the Regional Environmental Strategic Framework 2015-2020 approved at the end of 2014, which includes a strategy for IWRM.

Additionally, universities in the CARIBBEAN as well as the CSUCA (the acronym in Spanish for the Higher University Council of Central American Universities) assign importance to the issues of water and climate change, and show their interest with specific research and education actions. However, the impact of these actions is limited.

In terms of climate change, we can highlight the Regional School of Sanitary Engineering and Water Resources of the University of San Carlos of Guatemala ERIS-USAC (for its acronym in Spanish), and the University of the West Indies and the Caribbean.

It is worth mentioning that the role of social and intergovernmental networks that lobby for the interests of global society – such as Oxfam, Greenpeace and GWP – as well as networks that represent special groups constituted by organizations of women, youth, indigenous peoples, unions, and cooperatives – such as the Global Water Alliance (GWA), among others – is important even when their influence is limited, because although they make proposals, they do not make decisions and often lack resources; but they are legitimized to act and influence the position of different stakeholders, and thus, political decisions.

5.3. Analysis of compared legislation between countries

In Annex 1 we present a summary of the legal framework linked to water by country, whereas in this chapter we present a systematized analysis of legislation around key legal institutions for water security, IWRM, climate change and decentralization.

The analysis identifies a clear difference in the way in which public water security policies are approached between island states and countries located on the continent; in fact, when applying the same weighting to the indicators

for those countries, the maximum level is set at 9.08, the average at 5.0, and the minimum at 0.33. The countries that are weighted close to the minimum are precisely islands with small territories and low or non-existent availability of fresh water, and therefore with nothing to regulate from the perspective of water rights. Among the countries with a weighting close to the average, we found island states as well as countries on the continent; and those that are highly weighted are all on the continent, and have large amounts of fresh

water and a demand that goes beyond drinking water and sanitation to cover other productive uses and regulations for environmental management.

For this reason, an adjustment factor was applied to modify the location of most of the island states, placing them in a higher position, higher even than the continental states. In this round, the lowest weighting was placed at 4.33, the average at 7.377, and the highest at 9.207 (Table 5).

Table 5. CARICOM and SICA. Results of the evaluation of legal indicators related to Water Security. Source: Colom (2014)

Region	Country	General Score	Adjusted Score	General Weighting	Adjusted Weighting
CARICOM	Antigua and Barbuda	4.79	8.667		
	Commonwealth of the Bahamas	3.50	7.377		average
	Barbados	4.33	8.207		
	Belize	7.11	7.11		
	Dominica	5.00	8.877	average	
	Grenada	3.89	7.767		
	Guyana	3.33	7.207		
	Haiti	3.42	7.297		
	Jamaica	5.33	9.207		high
	Montserrat	2.33	6.207		
	St. Kitts and Nevis Federation	0.33	4.207	low	low
	Saint Lucia	3.11	6.987		
	Saint Vincent and the Grenadines	4.44	8.317		
	Suriname	5.53	5.53		
	Trinidad and Tobago	3.33	7.207		average
SICA	Costa Rica	6.00	6.00		
	El Salvador	4.33	4.33		
	Guatemala	7.33	7.33		
	Honduras	8.00	8.00		
	Nicaragua	8.11	8.11		
	Panama	7.33	7.33		
	Dominican Republic	9.08	9.08	high	

Water resources legislation, generally expressed as water laws, is present in countries with a reasonable amount of fresh water and with a territory larger than 10,000 km², which is the case in Belize, Guyana, Jamaica, Suriname, Costa Rica, Honduras, Nicaragua and Panama in the SICA region, but not so in El Salvador and Guatemala, which have not yet overcome the sectoral and partial approach to water use. General characteristics shared by all the countries include establishing specific regimes to regulate the public services of water and sanitation, as well as risk management; watershed protection is limited to the for continental states and Jamaica.

In the region of Central America it is not possible to identify a single common model of water management; certain agencies are part of the environmental sector, with legal and functional independence, as is the case in Honduras and Nicaragua; others are part of a ministry or environmental authority, as in Costa Rica and Panama. Guatemala and El Salvador still do not have a national water authority.

The common denominator of all legal systems in all the countries in both regions is the constitutional regime that guarantees private property, which means that the water rights granted to non-governmental individual or collective persons to make use of public water and/or to provide public services, are protected by the Constitution, which favors private and collective participation and investment in water governance. It is the Water Law that establishes the system of water rights.

In terms of conservation of water in watersheds, the trend observed in recent legislation is to include the institutional mechanism of water

management through watersheds in the water laws, as in the case of Honduras in 2009 and Nicaragua in 2007; whereas Jamaica adopted a general watershed law in 1963, and Panama in 2002, without including the Canal watershed, which has a special law. Guatemala issues specific laws to manage the natural and cultural resources of strategic watersheds, without establishing functions to assign water rights or articulate this ensemble of authorities to a national system of water management.

No country expressly divides its national territory, either politically or administratively, by watersheds, but aside from the laws in Honduras and Nicaragua, empirical evidence indicates that in every SICA state and Jamaica, the watershed is adopted as a unit for planning, management, follow-up and evaluation in plans, programs and projects related to water management, and for the conservation of other natural resources.

In terms of measures to control the deterioration and pollution, we identified the countries that have general dispositions, either in the waters law or in the environmental law, among them were Antigua and Barbuda, Dominica, Guyana, Jamaica, Suriname, and all the SICA country members.

With regard to risk management, public policies arise as a response to the impact of extraordinary hydrometeorological events, and have been present in countries and regional departments since the beginning of the 20th Century. At the national level, they are expressed in public order laws that over the years have evolved into legal systems for prevention, management and reconstruction – as in Antigua and Barbuda, Jamaica and all of the SICA states – and into the creation of regional agencies

such as CDERA and CEPREDENAC.

As regards climate change, all the member states of CARICOM and SICA are part of the United Nations Framework Convention on Climate Change, the Kyoto Protocol, and the United Nations Convention on the Battle against Desertification and Drought; most of them have passed specific national public policies to confront the impacts of climate change.

The Dominican Republic articulates climate change measures to the goals of the General Development Plan approved as a law by the Legislative Assembly; in Nicaragua, the Legislative Assembly instructs the Executive Branch to draft a specific policy; in Honduras, Costa Rica, and recently in Panama, they are drafted through the initiative of the Executive Branch; El Salvador includes measures at a governmental level; and Guatemala introduces them in the National Development Plan in the form of indications.

The regulations for public water and sanitation services are present in all CARICOM and SICA countries and demonstrate two tendencies: one that decentralizes services in the local governments without defining a governing or regulating system at the national level, as seen in El Salvador and Guatemala; the other, more generalized, legally creates a regulatory body and a ruling body, and defines the functions, rights and duties of the provider as well as the rights and obligations of the users. The latter is the case of Costa Rica, Honduras, Nicaragua, Panama, and all CARICOM countries.

The island states of Antigua and Barbuda, Bahamas, Barbados, Dominica, Grenada, Montserrat, Saint Lucia, and Saint Vincent and Grenadines, do not have natural

supplies of fresh water, or they do in insignificant amounts, which explains the emphasis given to the legal regime for the public services of water and sanitation, around which they establish measures for risk management and adaptation to climate change; it also explains why they do not have water laws. To obtain a fresh water supply, these countries desalinate and import fresh water. Jamaica is the exception, as it has a management system for water resources and has instated a law for territorial management based on watersheds (see Annex 1).

In the CARICOM countries, on the other hand, the provision of water and sanitation services is designated by law to a public company; in Guatemala, Honduras and Costa Rica, the law assigns the responsibility to the municipality; in El Salvador, Honduras, Nicaragua, Costa Rica and Panama, there are national entities dedicated to promoting access to these services; in Honduras, the Water Administration Boards (JASAS, for the acronym in Spanish) legally form part of the national institutionalality of small providers; Nicaragua has Drinking Water and Sanitation Committees (CAPS, for the acronym in Spanish); Costa Rica has Associations for Administration of Rural Aqueducts and Sewer Systems (ASADAS for the acronym in Spanish); and in Panama are found the Rural Water and Aqueduct Boards (JAAR for the acronym in Spanish).

Citizen participation as a mechanism to strengthen democracy and good government, a central element of decentralization, is linked to the rights of freedom of speech and access to public information, guaranteed by the constitution of all CARICOM and SICA countries.

Guatemala stands out because it integrates citizen participation in the process of decision making for planning and budgetary allocation, through a system of development councils organized at the national, regional, municipal and community level. The Dominican Republic also has a local participative investment system called the "Participative Budget".

Costa Rica, Guatemala, Honduras and Nicaragua, together with Dominica, are the only countries that have ratified Convention 169 on Indigenous and Tribal Peoples of the International Labor Organization (ILO), which establishes the right to prior and informed consultation with indigenous populations.

Antigua and Barbuda, Bahamas, Belize, Guyana, Jamaica, Saint Vincent and Grenadines, Trinidad and Tobago, Guatemala, El Salvador, Honduras, Nicaragua, Panama and the Dominican Republic have adopted laws on access to information; all the countries in Central America except Belize have approved the United Nations Convention against Corruption; and in the Caribbean, only the Dominican Republic, Grenada, Saint Kitts and Nevis, Saint Vincent and Grenadines, Suriname and Montserrat have yet to do so.

In general, public policies, laws and institutions from CARICOM and SICA countries do not contemplate specific mechanisms to resolve conflicts related to water. Certain provisions can be identified in the legal regimes for public services established in Antigua and Barbuda, Belize, Dominica, Honduras, and Nicaragua.

In terms of international waterways and transnational aquifers,

not one country has approved the Convention on International Waterways for Purposes other than Navigation¹⁹, which is completely justifiable in the case of island states that do not share territory with others²⁰. In the case of Central America, there are many international waterways, but there are only a few legal provisions in the treaties regarding borders that were signed at the end of the 19th Century or in the first decades of the 20th Century, and in the interpretation of these provisions as handed down by the Supreme Court of Justice (SCJ) (Colom, 2014). Despite the evident tension between Guatemala, Honduras and El Salvador in terms of the Ostua River–Lake Guija–Lempa River system, and the legal conflicts between Nicaragua and Costa Rica regarding the San Juan River, to date no bilateral or regional agreements have been signed to establish how to govern transnational surface or underground waters.

19 Adopted by the United Nations General Assembly in New York in 1997, in effect since August 2014.

20 Haiti and Dominican Republic have signed several bilateral conventions that address this issue.

5.4. Dominican Republic

The Dominican Republic shares the Island of Hispaniola with Haiti; it occupies a surface of 48,311 km² and has a population of 9,445,281. The State's commitment to water management and climate change is stated in the 2010 Constitution and is explicit in various laws; consequently, different institutions have been making this commitment a reality, taking on numerous functions. Table 1 shows the scope of action of the main entities that participate in water management in the country. The management roles are placed in the first column and the relevant user sectors in the heading.

The Secretary of State of the Presidency is responsible for the formulation of policies for the entire country. Particularly with regard to water resources, there is no governing body that is not linked to a specific use. Even though the National Institute for Water Resources (INDRHI, for its acronym in Spanish), an autonomous institution ascribed to the Ministry of the Environment and Natural Resources, has the mission to "promote better living conditions..., by means of the preservation and rational use of water resources, guaranteeing the availability of the resource in optimal quality, suitable quantity, and in a fair and appropriate fashion, with emphasis on water for the Irrigation Subsector"²¹, they do not maintain a record and control of all the types of uses given to bodies of water. However, they do an outstanding job in planning for water resources as part of the National Water Plan, which emphasizes infrastructure development.

Peña and Solanes (2003) comment that in the absence of a non-sectoral governing institution, there is a risk of tending to support projects or water allocations according to functional interests (be they productive or environmental), with the possibility of minimizing rele-

vant aspects, such as attention to the sources of supply, the security of investments or the economic quality of projects. Participative workshops with stakeholders in the Yaque del Sur watershed commented in this sense, that the mechanism for allocation of water rights needs to be improved, observing the principle of equity.

Continuing with planning and financing, Organic Law 1-12 for National Development Strategy has become a reference for planning in Dominican state institutions (Fundación Sur Futuro, 2014a). This Law is reinforced by Organic Laws 247-12 for Public Administration and 253-12 for Strengthening the State's Revenue-raising Capacities for Fiscal Sustainability and Sustainable Development; as is the approval, since 2013, of a yearly budget for pre-university public education equivalent to 4% of GDP. The coordination of sectoral planning is the responsibility of the Ministry of Economy, Planning and Development (MEPyD, for its acronym in Spanish), as defined in its Organic Law (Art. 2 and 3 of Law 496-06). It is expected that once the National Land-Use Plan is set in motion, it will also orient the protection of natural resources and climate change adaptation, along with the regionalization proposal of the MEPyD.

The importance of agriculture as

a water user and local economic driver highlights the role of the Ministry of Agriculture; however, the consultations and workshops conducted indicate that this institution has diminished its contribution and leadership.

In water management, monitoring, together with water information systems (about quality and quantity) are fundamental to the establishment of uses, administration of concessions and flows, development planning and risk management. The stakeholders consulted in the Yaque del Sur watershed commented that the lack of available data limits decision-making in the areas of intervention linked to water resources.

The lack of information about water availability in the watershed, along with low rates, may affect the adoption and investment in efficient and less contaminating practices. Fundación Sur Futuro (2014b) found that the rates charged for water in the irrigation systems do not encourage saving, as they are based on the surface irrigated and not on the volume of water used; also, in a survey on perceptions about water resources in the watershed, they found a variety of opinions regarding drought and water security.

The availability of reliable information also affects conflict resolution. Given the development of irrigation agriculture and the great amount of water it requires, it is in this sphere where conflicts occur most frequently and where independent, fair, decentralized entities are needed for monitoring, supervision and sanctioning, which were among the demands made by the stakeholders consulted in Yaque del Sur. For example, in the work-

21 <http://www.indrhi.gob.do/index.php/sobre-nosotros/mision-y-vision> (consulted on November 16th, 2015)

shops held in the Tamayo district, complaints were presented about the quality of water after its agricultural use, however, the municipality does not have information about water quality to attend to this issue or make decisions in this regard.

In terms of watershed management, the strategic convenience of planning investments with the understanding of the watershed

as a system is acknowledged, particularly regarding irrigation, risk management, water source protection and others. In the Dominican Republic, the focus on water management has veered towards engineering solutions and infrastructure, which in spite of representing important physical capital and a stronghold for water security, need to be complemented with solutions geared to

soil protection, water sources, and regulatory, economic and educational instruments. The commission for river channeling, riverbed adaptation and tailing dam sediment extraction of the Ministry of Environment and Natural Resources attends to the issue of sedimentation in rivers and reservoirs, related to the comprehensive management of watersheds and the risk of flooding.

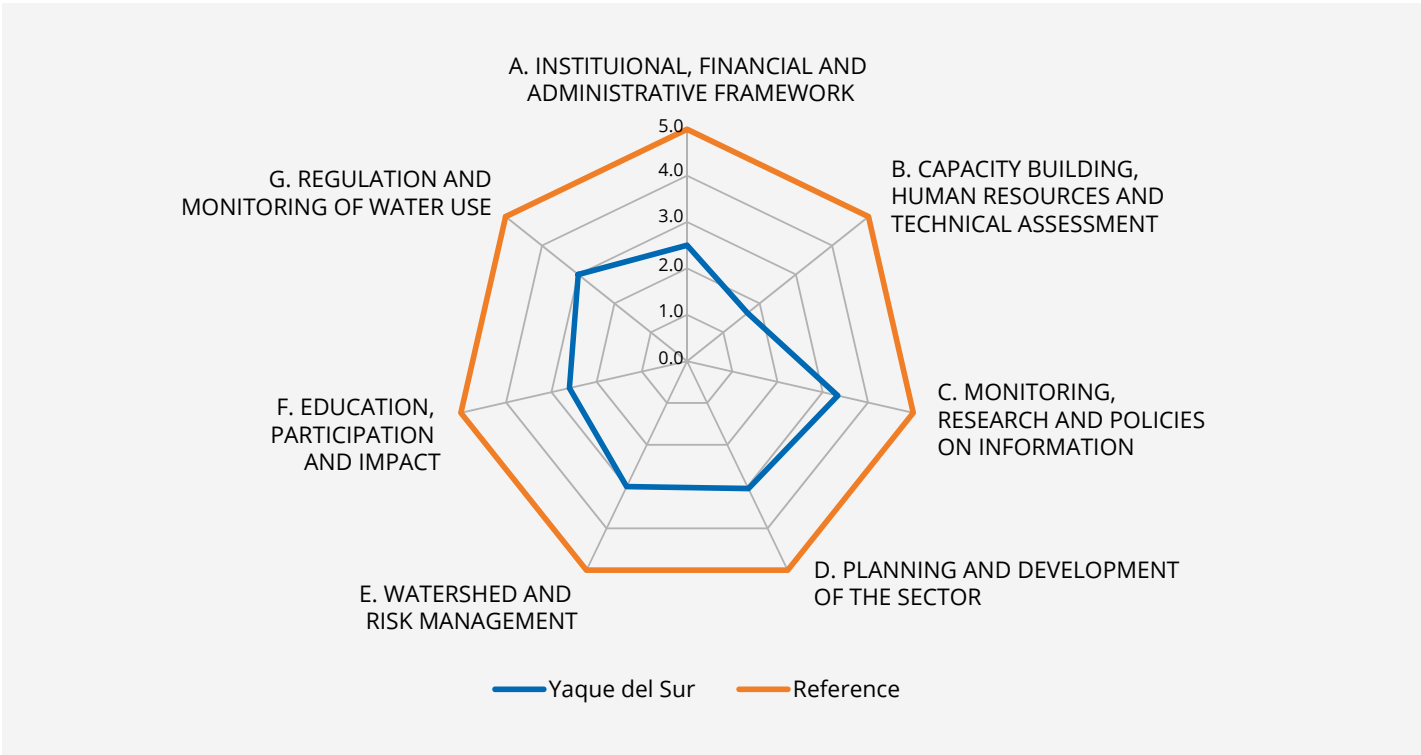


Figure 4. Water management ratings by relevant stakeholders in Yaque del Sur watershed.

The National System for Disaster Prevention, Mitigation and Response (SN-PMR, for its acronym in Spanish) is in charge of risk management. The National Emergency Commission (CNE, for its acronym in Spanish) is part of this system and creates the National Plans for Disaster Risk Management; the latest is from

2011. The system is also organized by Provincial and Municipal Committees for Prevention, Mitigation and Response. The consultations made in the municipalities indicated that there is a pretty good level of response to emergencies. However, it is important to clarify that risk management includes other stages

in addition to emergency response which tend not to receive the necessary attention.

In the area of climate change there are numerous initiatives promoted by the Ministry of Environment and Natural Resources, as well as the National Council on Climate Change and the Clean

Development Mechanism. Among their achievements the following can be cited: the Evaluation of Technological Needs for the adaptation and mitigation of climate change, between 2011 and 2012, in which priority was given to the areas of water resources, tourism and forestry with outstanding recommendations. This evaluation is supported by the 2010 National Forestry Strategy and the Plan for Economic Development Compatible with Climate Change (DECCC, for its acronym in Spanish), developed in 2011. That same year saw the publication of the Evaluation of Investment Flows and Financial Flows for Mitigation in the energy sector and for adaptation in the water and tourism sectors in the Dominican Republic. Also during that year, the 2011-2030 Strategic Plan for Climate Change (PECC, for its acronym in Spanish) was formulated, along with the National Policy on Climate Change, which enriches the National Development Strategy as an opportunity to incorporate within the ratified fiscal reform law a tax on high consumption vehicles, the first green tax fee in the Dominican Republic. The

National Strategy to Strengthen Human Resources and Capabilities towards Green Development with Low Emissions and Climate Resilience was published in 2012. Recently, the Council together with the Ministry of Agriculture published the National Strategy for Climate Change Adaptation in the Agricultural Sector of the Dominican Republic for the 2014-2020 period, with considerations that have a positive impact on national water security. Currently, the Climate Change Law is being formulated, which will be another step towards confronting this phenomenon in the country.

In the case of the drinking water and sanitation sector, Otáñez and Díaz (2011) talk about the lack of vision and plans to facilitate coordination, which by definition is the responsibility of INAPA. The lack of strategic plans forces people to work on projects with short-term perspectives, which affects the direction of the investments (ibid).

One element that stands out in Box 6 is the inexistence of a regulator of public services, with the exception

of the electric sector. The General Health Law 42-01, for instance, in articles 41 and 42 does not clarify whose responsibility it is to supervise the quality of drinking water services, which is critical to health and also a source of conflicts, as was discovered in the evaluation of municipal water security described further ahead. ECLAC (2014) suggests that the participation of autonomous regulatory entities is important for establishing prices and subsidies, water service quality, and themes of expansion, maintenance and economic stability of providers. The analysis made by Otáñez and Díaz (ibid) on the drinking water and sanitation sector indicates that enabling laws invest service providers with the functions of both providing and self-regulating their services, which can create vulnerability with regard to customers' rights and the quality of the services. Contreras et al (2015) carried out surveys in homes in four municipalities of the Yaque del Sur watershed and found a high incidence of diarrhea and parasites, which may be related to water quality in public systems.

Table 6. Water governance map in the Dominican Republic

	FUNCTION	GENERAL OR AS STATE POLICY	URBAN DRINKING WATER	RURAL DRINKING WATER
Governance	Policies, regulations	Secretary of State of the Presidency		
	Planning	Ministry of Economy, Planning and Development. Law 1-12		
	CC Adaptation	CNCCMDL, Ministry of the Environment		
	Conflict Resolution	PGR - Public Ministry. National Council on the Environment and Natural Resources.		
	Monitoring, Supervision and Sanctions	PGR - Public Ministry		
Social incidence	Communication and Education	Media, NGOs, M. of the Environment, Ministry of Education		
	Spaces for Participation and Dialogue	National Council of the Environment and Natural Resources. National Water Board	GASH	GASH
Services	Service Provider		INAPA, CAASD, CORAASAN, CORAAMOCA, CORAAPP, COAAROM, CORAAVEGA. Central Romana	INAPA, Community Rural Aqueduct Associations, CORAAs.
	Service Regulator	Pro Consumer, DIGENOR (Dominican Institute for Quality)	Ministry of Public Health. INAPA, M.of the Environment	Ministry of Public Health, INAPA, M.of the Environment
Decision-making support	Hydrologic monitoring and information systems	National Water Observatory-ONAMET. INDRHI, M.of the Environment. Integrated National Information System for Disaster Risks		
	Research	INDRHI, ONAMET, M. of the Environment, SGN and Universities: UNIBE, PUCMM, UASD, ISA, INTEC, UNPHU, UCNE, IDIAF		
	Technical advice and training	National Geological Service, UNPHU, ISA, INTEC, UASD, PUCMM, UASD, UCE.		
Intervention	Water source conservation and protection	INDRHI		
	Infrastructure	INDRHI	INAPA, CAASD, CORAASAN, CORAAMOCA, CORAAPP, COAAROM, CORAAVEGA, Central Romana, town councils, NGOs, International Cooperation	INAPA, Community Rural Aqueduct Associations CORAAs, town councils, NGOs, International Cooperation

URBAN SANITATION	RURAL SANITATION	AGRICULTURE	ENERGY	ECOSYSTEM	RISK MANAGEMENT
		Ministry of Agriculture	National Energy Commission	Ministry of the Environment	SNPMRD: CNPMRD
		INDRHI	National Energy Commission	Ministry of the Environment	CNE
		Ministry of Agriculture		Ministry of the Environment	
		Irrigation Board	Electricity Superintendence COPE	Ministry of the Environment	
		INDRHI	Electricity Superintendence	Ministry of the Environment	
		INDRHI	Water Observatory and COPE	M. of the Environment	
GASH	GASH	Irrigation Board	Reservoir Operations Committee		
INAPA, CAASD, CORAASAN, CORAAMOCA, CORAAPP, COAAROM, CORAAVEGA	INAPA, Town councils	INDRHI, Irrigation Board, Farmers Association	EGEHID (Hydroelectric generation)		9-1-1, COE, Commission for Natural Disaster Management
		COPE, INDRHI, CAC	Electricity Superintendence		
		INDRHI	EGEHID, COE, Electricity Superintendence	Ministry of the Environment	
				IDIAF	
		Ministry of Agriculture		IDIAF	CTN, EIGEO
		INDRHI		M. of the Environment, Local organizations, town councils	The commission for river channeling, riverbed adaptation and dam sediment extraction
INAPA, CAASD, CORAASAN, CORAAMOCA, CORAAPP, COAAROM, CORAAVEGA, town councils, NGOs, International Cooperation	INAPA, town councils, NGOs, International Cooperation	INDRHI	EGEHID	M. of the Environment, Local organizations, town councils, NGOs, International Cooperation	

There have been some interesting decentralization-centralization experiences with regards to potable water supply services. In 1955, During Rafael Trujillo's regime, the government transferred all responsibilities and assets of both water and sanitation sector to local town councils. But a few years later, in 1962, it was determined that this model had failed, so President Joaquín Balaguer created the National Institute for Aqueducts and Potable Water (INAPA, for its acronym in Spanish) under Law 5994, effectively returning to a centralized administration of all systems. In 1973, the Santo Domingo Aqueduct and Sewer Corporation (CAASD, for its acronym in Spanish) was formed and between 1997 and 1998 the following were created: Santo Domingo Aqueduct and Sewer Corporation (CAASD, for its acronym in Spanish), Santiago Aqueduct and Sewer Corporation (CORAASAN, for its acronym in Spanish), Puerto Plata Aqueduct and Sewer Corporation (CORAAPPLATA, for its acronym in Spanish), Moca Aqueduct and Sewer Corporation (CORAAMOCA, for its acronym in Spanish), La Romana Aqueduct and Sewer Corporation (CORAAROM, for its acronym in Spanish). In this way, the INAPA ended up responsible for providing service to intermediate cities and rural areas; however, INAPA also promoted the development of Community Rural Aqueduct Associations known as ASOCAR (for its acronym in Spanish) in these rural areas which have been charged with the operation and maintenance of aqueducts including the task of charging fees for provided water services.

According to the Law of the National District and Municipalities (176-07), the town councils have the obligation to offer (on their own or in association with others), the services of collection, treatment and final disposal of urban and

rural solid wastes, road cleaning, access to population centers, street reconstruction and maintenance, sidewalks, curbs and rural paths, public parks, slaughterhouses, markets, civil defense and protection, fire prevention and fire fighting, environmental protection, urban planning and basic social services (Art. 20, Law 176-07). However, in many of the municipalities studied, it was found that the quality of the solid waste collection service is irregular and there is little to no management of hazardous waste, such as hospital waste.

Nonetheless, the 2007 reform to municipal legislation has made it possible to promote a process of development of capacities in local governments led by the Ministry of Public Administration, the MEPyD, the Dominican Federation of Municipalities and their regional associations, along with the participation of numerous civil organizations. Given that supporting the administrative functions of local governments is a permanent and arduous task, the work of these institutions, even though active, should be continuously supported.

An important experience in the decentralization of competencies within water resource management has been promoted by the INDRHI [National Institute of Water Resources], by transferring the administration (with technical support) of secondary and tertiary irrigation systems to irrigation boards. By 2005, the INDRHI had organized 30 boards across the country, composed of 173 Irrigation Associations, grouping more than 77,000 users that cover approximately half of the irrigated surface of the country (Fundación Sur Futuro, 2014b). As in any participatory process, accompaniment, technical advising, training and information sharing are fundamental. Irrigation boards can benefit from an economy of scale and widen their attention, not only

for the construction of projects but also for maintenance and efficient use of irrigation.

As can be observed, the process of water management requires that many agents act in coordination, which is why it is relevant to strengthen inter-sectoral coordination spaces and roundtables for dialogue, such as the National Council for the Environment and Natural Resources, the National Water Roundtable, and the National Water Observatory. The latter, coordinated by the INDRHI, has become very important for drought processes that are increasingly longer (Fundación Sur Futuro, 2014b). Stakeholders in the watershed mentioned the need for the bodies that manage water to work in more coordinated fashion, that they exchange information and give more follow-up to decisions and agreements made in such spaces. In the Water, Sanitation and Hygiene sector, the Grupo GASH (GASH Group) led by the Ministry of Health, was created to facilitate the coordination between national, local, international stakeholders and United Nations organizations involved in disease prevention and control. In this rubric, the Committee for Health and Emergencies (CES from its acronym in Spanish) is the highest authority in public health emergencies.

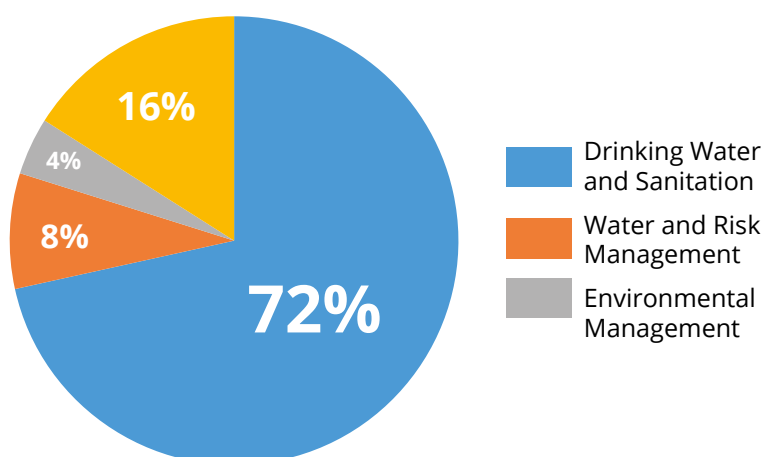
A powerful tool to promote development and social stability is to encourage civic awareness around the provision of services, environmental protection and water resource management (Peña y Solanes, *ibid*). Prominent NGOs have an important presence in the Yaque del Sur watershed, which facilitates a large part of awareness and educational work. However, watershed stakeholders also feel that it is important to have more scientific advice from universities and specialized centers, as well as more possibilities for training and professional education facilities

in the country's periphery, that is, decentralized educational centers.

Meanwhile, the participation of the media was qualified as poor in watershed themes. Regarding participation, it was suggested that gender considerations be included in strategies for dialogue and public consultations. Recently, the INDRHI, the Women's Ministry and the National Irrigation Council signed an agreement to promote the inclusion of an analytical perspective on gender in politics, plans, programs and projects.

Many positive experiences have been achieved in water management in the Yaque del Sur watershed, led by organizations and associations that are involved in the protection of forests and in the development and administration of small infrastructures for irrigation, potable water and hydroelectric power generation (Fundación Sur Futuro, 2014b). For example, in El Tetero, the community managed to get a hydroelectric plant built by INDRHI to compensate them for environmental services, with which they were able to build a school, clinic and irrigation system, and acquire a tractor.

Figure 5. Investments in water resources in the Dominican Republic.
Source: Sur Futuro (2014b)



Systematization of water management investments in the Dominican Republic, from the national to the local.

The analysis of the investments made in the water resource sector by Fundación Sur Futuro (2014a) showed that almost three fourths of the investment made in the country in the water sector has to do with providing drinking water and sanitation services (Figure 5) and, above all, with infrastructure construction (Table 7). Even though investment continues to grow year after year, the statistics of service coverage in the country according

to World Bank development indicators²² or CEPALSTAT²³ and studies by Otáñez and Díaz (ibid), show that the gap in coverage has increased, suggesting the need to revise either the management model (given that demand advances faster than supply) or the management of the internal administration of service providers, as suggested by Otáñez and Díaz. They affirm that commercial inefficiency has increased dependence on the national budget, which increases year after year.

²² <http://datos.bancomundial.org/indicadores-indicadores-del-desarrollo-mundial>

²³ http://estadisticas.cepal.org/cepalstat/WEB_CEPALSTAT/Portada.asp

Table 7. Sum of the investments of the main government institutions related to water resource management by sector during the years 2000 to 2010. Source: Fundación Sur Futuro (2014a).

INVESTMENTS BY SECTOR 2000-2010*	DRINKING WATER & SANITATION						WATER & IRRIGATION MANAGEMENT			ENVIRONMENTAL MANAGEMENT	HYDROELECTRIC ENERGY		
	INAPA			CORAAS			INDRHI			MINISTRY OF THE ENVIRONMENT	EGEHID		
	FI	FF	O&M	FI	FF	O&M	FI	FF	O&M	FF	FI	FF	O&M
Total investment for the 10 years classified (106 US\$ 2005)	846.9	195.8	127	1110.2	575.2	709.9	235.2	125.7	53.4	206.7	286.3	0.85	510.4
Percentage	72	17	11				57	30	13	100	36	0	64
Total (106 US\$ 2005)	1169.7			2395.3			414.21			206.67	797.51		
Yearly average (106 US\$ 2005)	97.5			199.6			35			17	66		

*All monetary flows were converted to constant 2005 US dollars (US\$), using the average official exchange rate between the Dominican peso and the US dollar for that year.

Table 7 shows the sum of investments made by the main government institutions related to the water resources management sector between the years 2000 and 2010. It also shows that the energy sector practically does not invest in concepts linked to programs (financial flows), among which watershed management could be included, but is limited to expansion or the installation of new physical assets, with investments mainly being in operation and maintenance. It is

possible that by investing more in watershed management, the need to invest in maintenance (due to silting in reservoirs) could be reduced. Watershed management programs could widen and improve the distribution of benefits among producers and vulnerable populations, and improve local quality of life.

Table 8 clearly shows the attention given to the agriculture sector in this watershed, highlighting Yaque del Sur's value as a provider of agricultural products and food. On the topic of water and sanitation, Núñez (2015), indicates that the investment in this watershed in relation to the total amount invested in the country is almost insignificant (1.8%); little investment from the EGEHID (1.6%) is also reported in proportion to the national total.

Table 8. Investments during the period 2000-2014 in Yaque del Sur by the main institutions related to water resource management. Source: Núñez (2015).

INSTITUTION	TOTAL IN USD	TYPE OF INVESTMENT (Investment 1 USD = RD\$ 44.71)
INAPA	19,701,465	14 Aqueduct systems (RD\$749,941,167) 1 Sanitary sewage system and waste water treatment plants (RD\$131,000,000)
INDRHI	193,041,358	Monte Grande Dam located in the lower part of the Yaque del Sur watershed (Resources allocated between 2000-2014: RD\$7,608,542,489) 5 Hydroelectric plants (rural hydroelectric projects and their main characteristics (RD\$308,071,266) 6 Irrigation systems (RD\$547,893,545) 3 Construction projects for flood control (RD\$167,240,500)
EGEHID	12,523,902	Palomino hydroelectric plant (RD\$560,000,000)
TOTAL	225,266,725	

5.4.1. Municipal management

In the Dominican Republic different articulated instruments are available for municipal planning, such as the Strategic Development Plan (10 years and more), the Municipal Development Plan (MDP) (4 years), the Annual Operating Plan (AOP) (which is the main instrument for monitoring the MDP and the link between this and the Municipal Budget), the Municipal Budget (1 year) and Municipal Participatory Budgeting (MPB).

Law 176-07 of the National District and Municipalities provides for the creation of Planning and Programming Offices by the

town councils, to guarantee the coordination and integration of government sectoral and gender equality policies with those of the municipality, as well as the evaluation of the results of management with respect to efficiency, efficacy, impact, relevance and visibility (Art. 124).

In order to support local governments, the General Directorate for Land Use and Development (DGODT, for its acronym in Spanish) of the MEPyD currently implements the Municipal Development Program (PRODEM for its acronym in Spanish), financed by the World Bank, and is supporting other municipalities in the country in the formulation

of their Municipal Development Plans and the financing of small infrastructure projects prioritized in these plans. This process presents a great opportunity to incorporate climate change adaptation and could constitute an ideal scenario to put into practice the guidelines presented here.

Some town councils have created Municipal Environmental Management Units, advised by the Department of Environmental Management of the Ministry of Environment and Natural Resources in accordance with the Environmental Law of 2000 (Law 64-00), to ensure compliance with environmental laws.

5.4.2. Pilot municipalities

5.4.2.1. Guayabal, Dominican Republic

The Municipality of Guayabal is located in the Azua Province in the central mountain range of the Dominican Republic. The municipality is recent, created by Law 216-04 of August 3rd, 2004. It used to belong to Padre las Casas.

Guayabal has an area of 235.6 km² and a population of 5,263 (Census 2010). The municipality is sensitive to extreme weather conditions, given that its main economic activity is subsistence rain-fed farming and its territory has been affected in various occasions by severe climate effects, two of them of great impact and permanence in the population's memory: hurricanes David (1979) and George (1998).

In order to describe the Municipality of Guayabal in terms of water security, there are statistics from the National Statistics Office (ONE, for its acronym in Spanish) available on their webpage "Your municipality in numbers"²⁴, as are the results of interviews conducted by INTEC in this municipality, the workshops offered by CATHALAC and interviews of key stakeholders, including local government officials.

Services

In Guayabal, 20% of homes have water that is supplied by the public network to the house; in household interviews, 62% said the water they receive is potable, but 92% said they treat the water before consuming it

and 37% said they buy bottled water. Regarding water quality, there has been media coverage alluding to problems with water quality in this municipality²⁵. In the urban area, the water coming from the INAPA systems is potabilized, while in rural areas it is the Water Committees that provide this service through aqueducts, for the most part rudimentary²⁶, and with less monitoring of quality. Water rates are low (63% of interviewees said the water rate is fair), as is the collection of fees (Otáñez and Díaz, 2011). This could explain why the Water Committees have difficulties in repairing facilities. A person in the municipality describes how some communities in Guayabal solve drinking water supply issues:

"The aqueduct that was damaged by a hurricane was replaced with international aid. INAPA replaced the pump that was damaged but it has not been put into operation yet, so the community uses water from an irrigation system. When pipes break, the Irrigation Board solves it."

The ONE reports that 71% of homes have no toilet inside the house, that there is not a sanitary sewage system and that 36% of the population lacks garbage collection systems.

Health

The conditions described may be having repercussions on health: in the home interviews, 47% of interviewees said they often suffer from diarrhea and 54% from intestinal parasites. Likewise, 11% said they often suffered from dengue

and 6.3% from malaria; the latter diseases are related to stagnant water.

On the topic of health, it was said during the interviews that there are occasional visits from medical missions, organized by the "absent Guayabaleros" or professionals who have left the town and return every year to provide their support through services such as odontology, cardiology, psychologists, learning disabilities specialists, and others.

Water and Development

Regarding the importance of water to the municipality's economy, 62% of Guayabal homes engage in agricultural production. The largest source of employment in Guayabal is mountain agriculture - short cycle, rain fed, carried out on terrains that for the most part have slopes greater than 30 degrees. The main crops are beans, pigeon peas, corn and potatoes, which account for more than 40% of incomes, as well as other short cycle crops (Fundación Sur Futuro, 2012b).

In general, the topography makes it difficult to establish irrigation systems, and the few existing ones function mostly with gravity and are not very efficient. During the workshops it was commented that cattle farming activities have also been affected by drought, due to the lack of pasture. In the face of these threats, farmers in this municipality have limited access to agriculture credit and support programs, which diminishes their adaptation capacity.

²⁴ <http://foro.one.gob.do/perfiles/>. Consulted in November of 2015.

²⁵ <http://eldia.com.do/acueducto-guayabal-sin-filtro/>

²⁶ Information from FG

Food security

In terms of food security, in 2011 it was reported that on a national level, 15.4% of the population consumed a diet that fell below the level of energy required and 11% of infants were found to be underweight at birth in 2007²⁷. This calls attention to the type of foods being produced in the field and their destination; although agricultural production represents a strength in terms of food security, the farmer's profile is changing towards exports (UNDP, 2013).

Energy security

Most households (84%) have electricity, but as in the rest of the country, they suffer from constant outages. Also, 32.9% of households use fossil fuels for cooking²⁸. It is worth noting that the Yaque del Sur watershed has an installed capacity of 19.4 MW of hydroelectric generation that is made available through the national network.

Risks

As mentioned before, Guayabal is highly vulnerable to climate extremes; hurricanes David and George caused severe damage and caused the migration of nearly 3,000 people²⁹. This is a remote municipality that tends to be left without communication due to overflows, especially from the Las Cuevas River, near the only access road from San Juan de la Maguana, passing by Las Yayas and Padre Las Casas. Recently, however, as an adaptation measure, the national government completed construction of a bridge that crosses Las Cuevas

River, providing significant relief to Guayabal. A municipal official describes the situation when communication is cut off:

"The main problem of Guayabal is communication. How to bring food to remote communities? We coordinate with the Santo Domingo Civil Defense and the Governor of Azua, but sometimes they take up to three days to arrive due to rain and clouds, consequently small shops run out of supplies. When helicopters come, people fight over food, which is why helicopters no longer want to come down and just throw food from up high and it gets lost. The government helps by renting bulldozers and providing fuel to extract the crops, they also make paths by dumping resistant material to be able to pass."

Regarding other means of communication, the ONE reports that only 26% of homes in the municipality have a landline or a cellphone; 0.2% have connection to Internet; 3% have a computer; and there are no A.M. or F.M. radio stations.

In general, interviewees agreed that there is good community organization for responding to natural disasters, including the existence of shelters. In the household interviews, 53% of interviewees said they know the emergency plans; and 48% said they had received some sort of recovery aid during an emergency situation.

Water sources

The Guayabal municipality prioritized, as the main threat to water safety, the deterioration of water sources. Participants described the problem in the following terms:

"There is destruction of trees, uncontrolled forest burning, cutting, and lack of care for trees

at the main water sources."

"There is a lack of planning, there is no reforestation where it's really needed, where the water sources are born; the existing Land Use Plan is not followed. The most vulnerable areas, where the water sources are, have not been reforested."

"There is a lack of presence of central government entities; lack of knowledge about the laws and regulations related to water management; lack of technical assistance in this topic."

"There is a lack of surveillance and sanctions are not enforced: a person starts a fire that destroys thousands of trees and is not punished, or the law is not enforced. When environmental laws are broken, the corresponding penalties are not applied."

In the Guayabal municipality the main water source is superficial, originating in Las Cuevas River. This sub-basin has the lowest level of water production of the entire Yaque del Sur watershed (Figure 9), which is between 8 and 21 mm per year.

In general, the whole Yaque del Sur watershed has a high production of sediments. Particularly the Las Cuevas River sub-basin has a production of 2.4 to 3.2 ton/ha, although the Río del Medio has an even greater production of up to 4 ton/ha per year. A large part of this material is gravel that is highly erosive and causes frequent road blockage.

Given this vulnerability, in 2012 the Fundación Sur Futuro finished an updated Master Plan for the management of the upper watersheds of the Sabana Yegua dam (PMPSY, for its acronym in Spanish), which corresponds to the

²⁷ <http://apps.who.int/nutrition/landscape/report.aspx?iso=dom>

²⁸ <http://foro.one.gob.do/perfiles/>

²⁹ Based on personal communication with the mayor.

upper part of the Yaque del Sur watershed. This plan has six central themes:

- ▶ Improving the quality of life of the watershed's inhabitants;
- ▶ Sustainable management of natural resources (physical and biological), the preservation of biodiversity and protected areas;
- ▶ Development of sustainable economic activities;
- ▶ Compliance with current sectoral laws and international agreements;
- ▶ Active stakeholder participation;
- ▶ Generation and acquisition of resources for sustainable land management.

The Plan is broad and is implemented in various municipalities. In Guayabal, the benefits of this project are well known. Here are some testimonials collected during gatherings and interviews about the strengths of municipal capacities with regard to the protection of water sources that contribute to water security:

- ▶ *"There is an environmental brigade";*
- ▶ *"The information gathered in the Land Use Plan is abundant and useful for decision-making";*
- ▶ *"Experiences in restoration and reforestation have been developed due to the work done in Las Cuevas River, Corozo Creek and Agua de la Piedra River";*
- ▶ *"The Fundación Sur Futuro, the Ministry of Environment and Natural Resources and CEPROS have conducted training sessions, for example, the workshop on pesticide management in the production of organic fertilizer, and the certification in water management";*

- ▶ *"Young people took part in the reforestation day, with primary and high school students";*
- ▶ *"Alliances were established with Sur Futuro, community associations, INAPA, Environment and the INDRHI for the preservation of the upper watershed of Las Cuevas River";*
- ▶ *"Alliances were established with INDRHI, INAPA and Environment for the preservation of Agua de la Piedra River";*
- ▶ *"Sur Futuro contributed towards the construction of the El Recodo community hydroelectric plant";*
- ▶ *"Sur Futuro and INAPA offer financing for the protection of the water sources"*

It is evident that the municipality has made very positive progress with regard to natural resources, even though for guayabaleros, the topic of forest degradation continues to be of top priority. The challenges pointed out during workshops to stop the trend towards deforestation were as follows:

- ▶ *"The community participates very little in caring for the forest"*
- ▶ *"There are no plans to protect other water sources"*
- ▶ *"Despite the effort being made, the impact of these measures is not noticeable. Reforestation work has been taking place since the 1980's and the municipality still looks deforested, given the lack of follow-up to the reforestation";*
- ▶ *"More resources are required to strengthen capacities, protect water sources and improve water services";*
- ▶ *"We have no help to provide follow-up and assessment";*
- ▶ *"A brigade for planting ornamental and fruit trees is required".*

Governance

In 2008, there was a total of one private and nine public education centers in Guayabal, with the highest level being middle school; for students who wish to continue their studies, they have to leave the municipality.

There are various grassroots organizations, such as irrigation boards, neighborhood councils, producers' associations, agricultural producers' associations, relief associations and cooperatives, mothers and youth clubs (Fundación Sur Futuro, 2012b), although it became clear during the workshops that the participation of these organizations in the development of the municipality is limited.

It was explained that 25% of the municipal budget goes to cover salaries, 40% to making investments and a certain amount is set aside to support elderly people with medical prescriptions, and also to support students with transportation fees. Each year the Participatory Budget is formulated in the Municipal Assembly to define projects in the area of investments.

With regards to municipal intervention in water management, it is mostly limited to emergency response, solid waste collection, riverbed maintenance for overflow control, construction of small drainage and internal water systems. "There is a lack of personnel within the municipality assigned to forest preservation and water protection. There are no full-time technicians. We need more technicians and a sub-director of natural resources in the community. The municipality has three forestry technicians and the UGAM does not coordinate with the municipality," were some of the observations made during the workshops.

This municipality does not have a Municipal Development Plan, similar to other municipalities in which the General Directorate for Land Use and Development of the Ministry of Economy, Planning and Development has directed efforts. Therefore, the measures that have emerged from the work by CATHALAC represent an opportunity for the Guayabal municipality to promote the inclusion of adaptation measures for water security, planned in accordance with the National System of Planning and Public Investment.

Summary of the evaluation of water security indicators

In summary, water security in the Guayabal municipality was evaluated through 30 indicators related to eight topics into which the concept was divided. On a scale from 0 to 100, Guayabal received a rating of 64. Figure 6 illustrates the municipality's general performance. The number inside the bars refers to the number of indicators with that rating. It can be observed that the lower performing topics are those dealing with water, development and health, which in turn are related to services. In addition, all of the governance indicators reveal "average" results. The topic of water sources received ratings from average to satisfactory.

5.4.2.2. Tamayo, Dominican Republic

The Tamayo municipality is located within the Baoruco Province, in the southern Dominican Republic. The municipality was created by Law 229 of March 18, 1943. Tamayo has a surface area of 434.3 km2 and a population of 26,772 (ONE, based on the 2010 Census). Tamayo has seven municipal districts: Tamayo (7,718), Uvilla (2,991), Santana (5,712), Monserrate (3,312), Cabeza de Toro (1,864), Mena (2,395), Santa Bárbara el 6 (2,780).

Drinking water, sanitation and solid waste services

Only 28% of households in the Tamayo urban area are supplied by the public network (2010) through the service offered by the INAPA; this network contains a water treat-

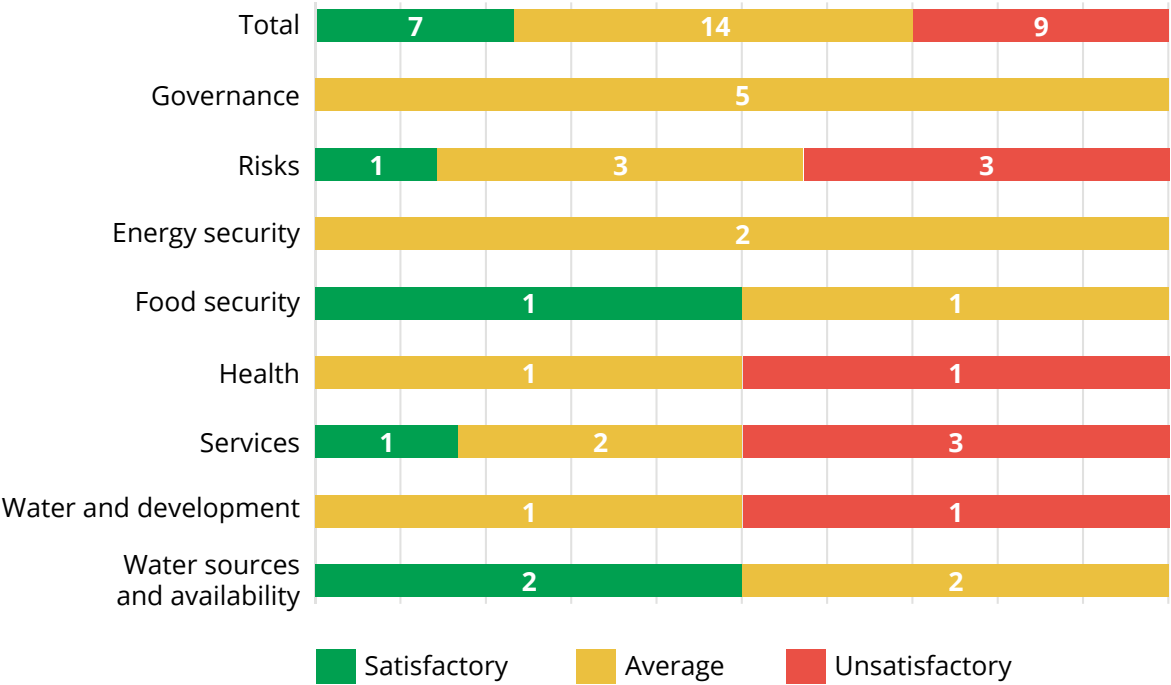


Figure 6. Results of the water security evaluation in the Guayabal municipality through 28 indicators

ment plant. In the household interviews, 67% of those interviewed were under the impression that the water they receive is not potable and 95% reported they have to buy water in large containers.

Regarding water rates, through semi-structured interviews, 39% said they are fair and 17% said they are unfair. The average fees are: \$0.21 per m3 of water and \$0.07 per m3 of sewage.

One municipal official informed that *"between INAPA and the municipality there is no communication. When something gets damaged, the municipality often has to intervene. For example, when the municipality has to fix a road, the opportunity is used to fix leaks. Currently, below the Santa Ana (Arroyo Grande) dam there is insufficient water, so there are plans to compensate with an intake from the Monte Grande dam."*

"In the rural area, [the official goes on to say] the INAPA does not intervene, many of the aqueducts were built by ASURO (the Southwest Irrigation Association). Some communities have their own wells and pumps. Some aqueducts are operated by the community with the help of Pastoral Social (Caritas Dominicana). A large part of the funding comes from non-governmental organizations. Sometimes the Town council helps, for example, if the pump breaks down. On one occasion, in a non-electrified community of approximately 60 houses, the council rebuilt the aqueduct and installed a solar panel, but the conventional pump they brought did not work, so they had to bring another one from Miami that was appropriate for the panel."

In rural areas, systems are susceptible to contamination because there is no strict surveillance

system; the use of appropriate technology can be decisive and financial sustainability is not easy. For this reason, they often depend on other entities, especially NGOs.

During workshops and interviews people commented on water service quality problems, highlighting the need for a regulating entity to provide technical and financial support to municipal and community water systems.

Municipal statistics indicate that 67% of homes have no indoor toilets. Interviewees commented that houses do have septic tanks, but there are no companies offering cleaning services, so people who are not necessarily qualified are paid to do this dangerous job. The sewer system, as well as the Santa Ana irrigation canal that collects rainwater, is full of sludge, obstructs drainage, which contributes to water stagnation and the proliferation of mosquitoes. As an alternative to this problem, the municipality builds filtering wells.

With regard to waste collection, districts offer this service to households free of charge, through a budget they receive according to the size of their populations. The ONE points out that almost 28% of homes do not receive this service. The town council uses dump trucks (not compaction equipment) and garbage is collected without any classification, including hospital waste. The dump is open-air and lacks any sort of management. In rural areas, communities burn their trash.

Health

In household surveys, 14% indicated that they suffer from dengue frequently and 19% from malaria; chikungunya is another risk related

directly to stagnant water to which the Ministry of Public Health issued a country-wide epidemiological alert due to the presence of this disease in 2014.

In relation to sanitation systems, organizations in the United Nations System³⁰ found a connection between improved sanitation system coverage and infant mortality; and the Azua and Bahoruco provinces present the highest infant mortality rates in the Dominican Republic³¹. In surveys, 54% of those who answered indicated that they suffered from frequent bouts of diarrhea, while 75% suffered from parasites.

Water and development

In the Tamayo municipality, the main economic activity is agriculture, particularly sugar cane and Musaceae (bananas). This activity is well-developed and attracts laborers and financial services that can offer support during a possible emergency situation, for instance, in a climate emergency. Access to credit, financial support and subsidies are readily available, especially for the more developed agriculture sector³².

This agricultural activity demands great amounts of water, supplied through an extensive irrigation system via canals. These canals tend not to receive adequate maintenance in the removal of weeds and residue which makes them inefficient resulting in water loss, either by infiltration or transpiration³³.

The greatest water user is the Sugar Consortium. There is an agreement on water use among

30 <http://www.un.org/spanish/waterforlifedecade/sanitation.shtml>

31 <http://apps.who.int/nutrition/landscape/report.aspx?iso=dom>

32 Based on the participatory workshops.

33 Field visits, interviews and participatory workshops.

its stakeholders, but it tends to be heavily affected during the dry season, causing difficulties in access for small farmers and some communities. These issues are discussed in irrigation board meetings in Tamayo and Barahona, with the participation of the INDRHI and the Ministry of Agriculture.

The multipurpose Monte Grande project currently under construction upstream from the municipality is expected to have positive impacts both in water availability for farmers, aqueducts, and for flood mitigation.

Another linked theme to production and water is pollution. In this municipality, a risk factor contributing to water pollution was identified due to industrial uses. It was determined that few production systems are enrolled in cleaner production. There exist many opportunities for companies to make positive contributions to water management, not only in irrigation systems but also in the reduction of agrochemicals and water use in banana wash tanks, waste management, etc.³⁴

Food security

As mentioned previously, the contribution of agriculture to the local economy is significant. Almost 30% of homes engage in agricultural production with 39,554 plots known as *tareas* (with a dimension of 69.03 m²) recorded in the municipality as peasant settlements (2009)³⁵.

The main crops grown in the lower basin of Yaque del Sur are sugar cane, musaceae, paddy rice, mangos, guava and mangosteen;

cacao and green coffee are also grown (UNDP, 2013).

Many of the crops produced in the watershed are grown for export (ibid), which has an impact on food security. In 2011, 15.4% of the country's population consumed a diet with a lower caloric value than required, and in 2007, 11% of infants on a national level were born underweight³⁶.

Energy security

Ninety point six percent of households have access to electricity services³⁷, although with constant power outages. Some districts lack the service³⁸, and another 24.5% of homes use solid fuels for cooking¹⁷. According to the National Emergency Commission (CNE, for its acronym in Spanish) (2014), 87.5% the internal national supply depends on non-renewable resources, all imported, and 12.5% on renewable sources produced locally. The Yaque del Sur watershed has a joint energy production of 19.4 MW through the Sabaneta and Sabana Yegua dams.

Water sources

The pressure on the Yaque del Sur River at this point is high, mainly due to the use of water for agriculture and electricity. Agriculture uses water from aboveground sources, while the industrial sector depends mostly on underground waters; the domestic sector uses both source types.

According to INAPA, the water quality at the sources is characterized by high levels of nutrients, organic matter and bacterial

contamination (Sur Futuro, 2015). The opinion of interviewees is consistent with this evaluation. As for the sediments produced by the Yaque del Sur River, CATHALAC calculated that the yearly total is currently 2.4 ton/ha (Guardia, 2015).

Regarding forest cover and water source protection, 19% of the municipal area has some type of forest (ibid). A Municipal Development Plan was found, but with very limited distribution, that suggests similarly poor implementation.

The municipality has forest nurseries, reforestation brigades, as well as fire fighting equipment. Public awareness campaigns are carried out, although during participatory workshops, people commented on the need for personnel with knowledge about hydrology and water conflict management.

Risks

The Tamayo municipality is affected by extreme weather in the form of both excessive water and water scarcity. In 1998, for instance, hurricane George left the municipality buried in water and mud, while droughts make vulnerable the main local economic activities, provoking impacts in agricultural production and tension among large producers, small producers and communities.

Interviewees identified the poor functioning of storm drains and the extraction of materials from rivers as factors leading to flooding vulnerability. Other aspects such as construction materials used in homes and land accessibility for communities are not entirely favorable.

34 Agricultural activity is well developed and generates labor demand, "bateyes" are where agricultural day labourers live, where they have deplorable conditions.

35 Your municipality in numbers (ONE) and IX National Population and Housing Census. Agricultural producers' context

36 <http://apps.who.int/nutrition/landscape/report.aspx?iso=dom>

37 Your municipality in numbers (ONE) and census statistics.

38 Based on personal interview with municipal officials.

On the other hand, key strengths were also identified in emergency response. Among them are the schools, which have been equipped as shelters; the penetration of the media (Radio Enriquillo stands out) and the presence of trained technicians in different institutions. The interviewees considered that there is good community organization to confront disasters. For example, the existence of shelters, food and medical assistance, road rehabilitation, support in repairing homes, as well as agricultural subsidies: 56% of households surveyed claimed to know of or to have directly received some sort of aid for recovery after a weather-related event.

Law 147-02 on Disaster Risk Management creates the Municipal Committees for Prevention, Mitigation and Response. The main institutions identified that are dedicated to emergencies in this municipality were: the Town council, Red Cross, Civil Defense, PMR, Community Emergency Committees (CCE, for its acronym in Spanish), Emergency School Committee (CEE, for its acronym in Spanish), CIAHE and the Local Committee for Emergency Humanitarian Affairs. Other possible allies are World Vision and the Center for Sustainable Development (CEDESO, for its acronym in Spanish).

The Municipal Mayor's office presides over the Program for Risk and Disaster Mitigation, which convenes during hurricane season or Holy Week (Easter), due to traffic and the influx of tourists. In the words of the municipal official: "the work consists of analyzing what we have available, what is needed and how to get it". At the time of this research, the Municipal Emergency Plan, created in participatory fashion by the Red Cross and Civil Defense, was due to be published.

The Town council plans ahead by acquiring flashlights, ropes, machetes, food, etc. However, it is only at the time of the emergency itself that the Council coordinates with potential allies to acquire fundamental needs, such as machinery, which is often obtained through the Sugar Consortium. Another ally is the Trucker's Union, which usually offers fuel for the hospital's electric generator. In addition, the provincial Governor manages public canteens.

Some experiences have been developed from risk mitigation; for example, alternative water sources, especially underground water, have been sought in the face of drought, as well as ways to improve water usage. Other strategies that are implemented are campaigns for vaccination and junk removal, both

of which are important to deal with vector-transmitted diseases.

The following elements of risk management that need to be improved were identified:

- ▶ Acquire an ambulance and a fire truck;
- ▶ Acquire tools for dealing with risks and improve their distribution to groups that need them;
- ▶ Improve the dissemination of available information, increase radio programs and the speed of delivery, and improve the educational level;
- ▶ Increase technical training in an ongoing manner, and search for opportunities to implement what is learned;
- ▶ Improve the coordination between institutions to face critical events, as well as the possibility of not meeting only when there is an emergency;
- ▶ Follow up more effectively on plans and projects for risk management;
- ▶ Offer sustainability to risk response agencies: PMR and Red Cross; and
- ▶ Strengthen the force of laws on risk management.

Governance

The Tamayo municipality is known for the leadership and credibility of its numerous peasant, neighborhood and community associations. This organisational maturity has promoted the presence and action of public entities³⁹. Here, the level of illiteracy in the population over 15 years of age is 22.6% (2010) and the highest level of education is university⁴⁰. The municipality has a Municipal Development Plan, but it lacks implementation.

Municipal officials interviewed said that among the municipality's public administration strengths is the technical capacity of its public employees, its modernization and its tax collection system; while among its key weaknesses are its low level of influence and capacity to resolve conflicts, as well as financial and personnel limitations⁴¹. Other interviewees pointed out weaknesses in compliance with

laws, poor awareness among citizens and a lack of interinstitutional coordination.

Investment allocation in the municipality was explained in the following way⁴²: "through participatory budgeting, neighborhoods meet in an assembly, voice their opinions and prioritize projects; the town council hires and supervises the construction, the community is the overseer and audits the quality, the percentage of cement, etc."⁴³

Law 176-07 of the National District and Municipalities allows the municipality to have broad participation in topics related to water management. However, their actions are centered on attending to emergencies, solid waste and the development of infrastructures, such as the construction of small drainage systems, drilling wells, waterways and acquiring pumps, among others.

A sensitive topic in the municipality, there is tension between the Sugar Consortium, the small farmers and the water committees over

the availability of this resource. In this case, the action of the municipality is very limited and mediation falls mainly to irrigation boards, the INDRHI and the Ministry of Agriculture⁴⁴.

Summary of the evaluation of water security indicators

In summary, water security was evaluated in the Tamayo municipality through 30 indicators related to the 8 topics into which the concept was divided. On a scale of 0 to 100, Tamayo received a rating of 60. Figure 7 shows the general performance of the municipality. The number inside the bars refers to the number of indicators with this rating. It can be observed that the topics with the poorest performance were water sources, services, and health resulting from the performance of the first two factors; followed by topics of governance and risk.

39 Based on workshops

40 Your municipality in numbers (ONE) and census statistics.

41 Law 166-03 for financing municipalities indicates that these should receive 10% of the State's income, however, in the interviews it was expressed that a smaller percentage is shared, which restricts municipal administration. The Budget System for the Public sector is regulated by Law 423-06.

42 Based on an interview with a municipal official.

43 The Public Planning and Investment System is established by Law 498-06.

44 Based on the workshops.

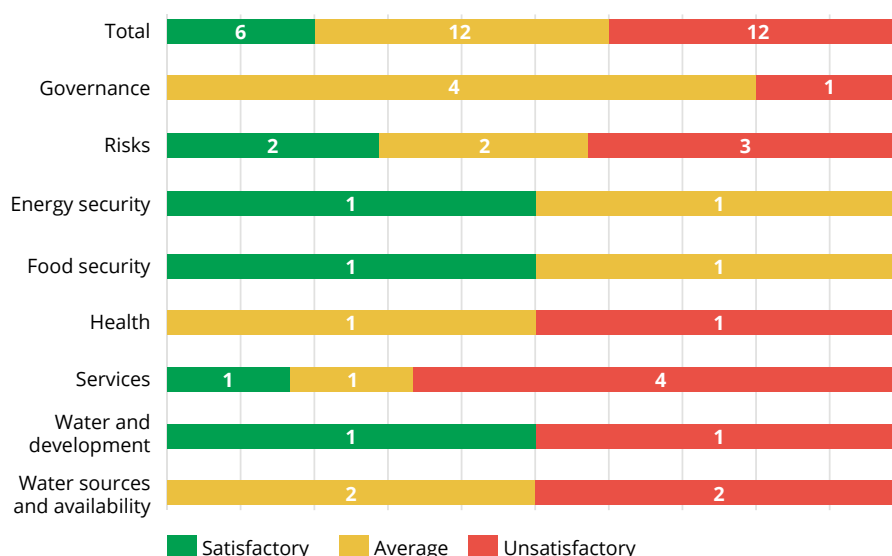


Figure 7. Tamayo water security index

5.5. Case studies: Guatemala

Historically, water resource development in Guatemala has been linked to uses and sectors, and that is how it is reflected in the legal and institutional regime. The Congress of the Republic has honored the constitutional mandates to regulate biodiversity, the environment, forests, mines and hydrocarbons, and has even approved international agreements and a special law on the topic of climate change. Although, as shown in Figure 4,

there is a legal gap with regards to water, even though articles 127 and 128 of the Magna Carta order that a special law be issued⁴⁵ (Colom, 1978, 2013).

In order to promote the transformation of public policy towards the creation of an institutional water plan, the Executive branch of the

government has promoted some the following measures: the 2010 Multi-year Sectoral Plan for the Environment and Water (PSMAA, for its acronym in Spanish), the 2011 National Water Policy, the State Policy in terms of the 2012 International Water Flows, and the 2013 Guatemala Water Agenda; although only the PSMAA defined and prioritized projects and identified budget gaps.

45 Political Constitution of the Republic of Guatemala, approved by the National Constituent Assembly on April 30, 1985.

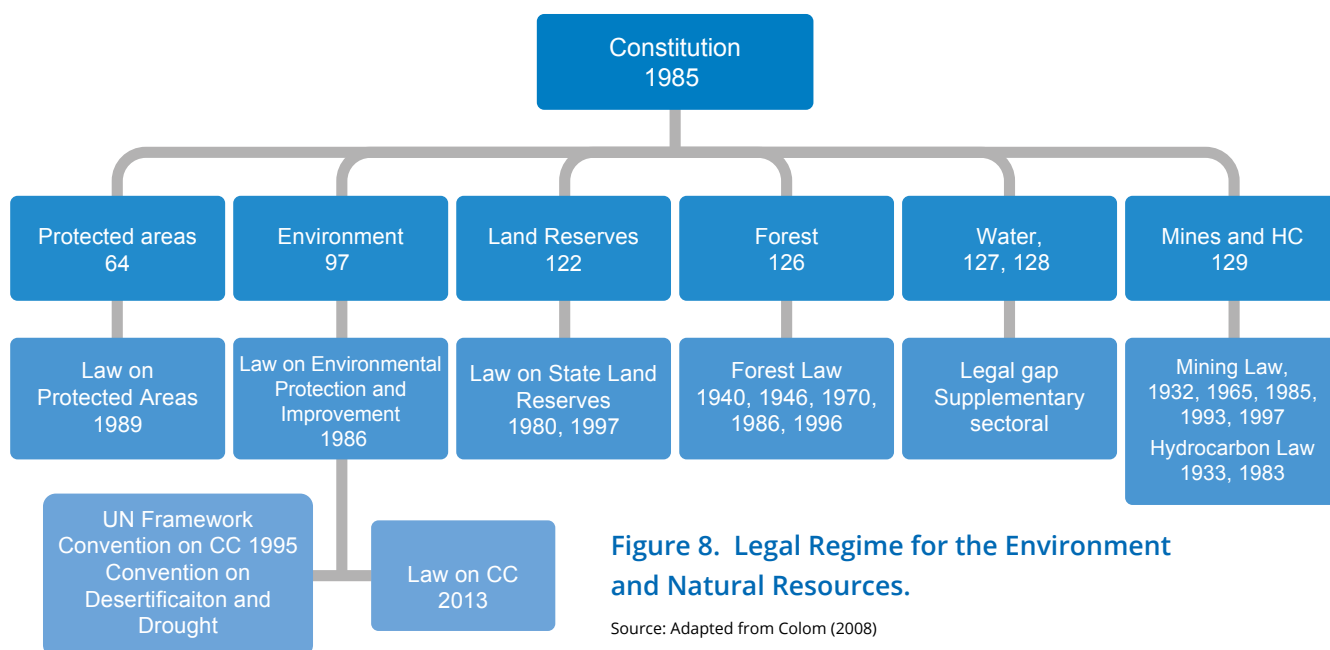


Figure 8. Legal Regime for the Environment and Natural Resources.

Source: Adapted from Colom (2008)

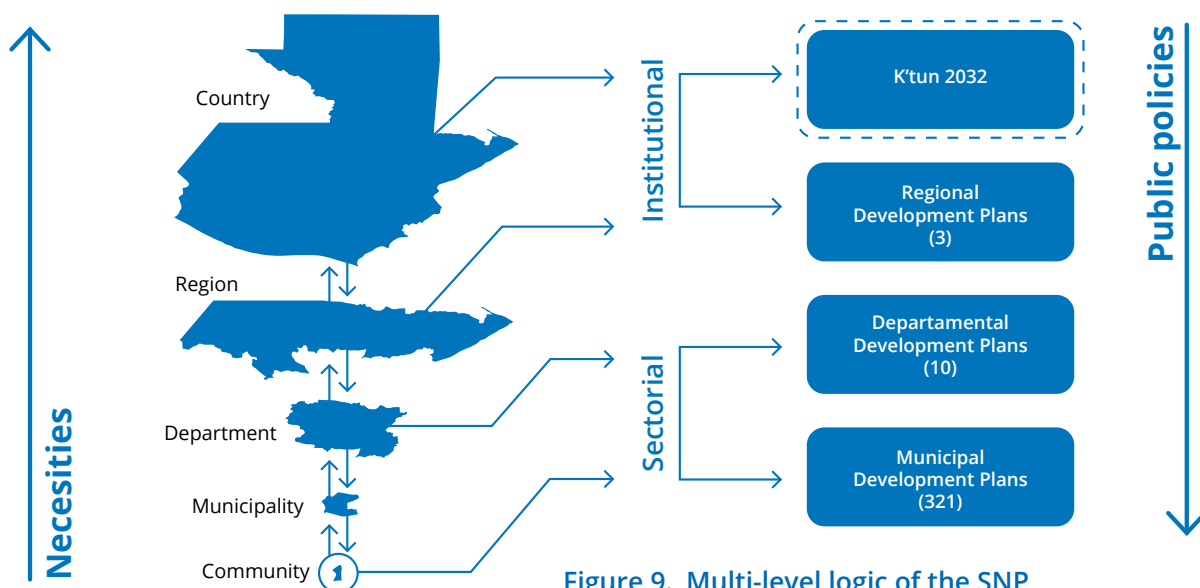


Figure 9. Multi-level logic of the SNP

Source: SEGEPLAN, 2014

The National Planning System (SNP, for its acronym in Spanish), run by the Secretary of the Presidency for Planning and Programming (SEGEPLAN, for its acronym in Spanish), articulates national and sectoral policies and harmonizes them with territorial policies, as well as coordinating the planning and budget according to multi-level objectives, as described in Figure 9 (SEGEPLAN, 2011). The IWRM focus is reflected in the SNP, and adaptation to climate change in the 35 development plans of the municipalities located in the Rio Samala Watershed and in the three departmental plans formulated by their respective development councils, with SEGEPLAN's technical assistance, between 2009 and 2010⁴⁶; also, in special regional plans, such as the 2010 Reconstruction and Transformation Plan; and finally, the K'atun Nuestra Guatemala 2032 National Development Plan⁴⁷.

Table 9 presents the Guatemala Water Governance Map. The law assigns general responsibilities related to some aspect of water management to: the National Institute of Seismology, Volcanology, Meteorology and Hydrology (INSIVUMEH, for its acronym in Spanish), the Ministry of Environment and Natural Resources (MARN, for its acronym in Spanish), the Ministry of Public Health and Social Assistance (MSPAS, for its acronym in Spanish) and the Ministry of Foreign Relations of Guatemala (MINEX, for its acronym in Spanish). The Ministry of Agriculture, Cattle Farming and Food (MAGA, for its

acronym in Spanish), the Ministry of Energy and Mines (MEM, for its acronym in Spanish), the Guatemalan Tourism Institute (INGUAT, for its acronym in Spanish), the National Institute of Electrification (INDE, for its acronym in Spanish), and the National Center for Epidemiology (CNE, for its acronym in Spanish) are entities that use the resource or provide an academic, technical or financial service, such as the Institute of Municipal Development (INFOM, for its acronym in Spanish), the Regional School of Sanitation Engineering of the University of San Carlos (ERIS, for its acronym in Spanish), the National Council for Science and Technology (CONCYT, for its acronym in Spanish) and the Center for Ocean and Aquaculture Studies (CEMA, for its acronym in Spanish)

Even though numerous public entities are identified, the gap in national supervision and regulation of the development of water resources stands out, along with the absence of a regulatory body in public water and sanitation services, the absence of a national regime to grant water rights, and the lack of specialized mechanisms to understand and resolve conflicts⁴⁸.

None of these institutions were created to promote and direct the development of water resources. As will be seen later, the lack of political leadership is evident, as well as a weak exercise of authority, the presence of institutional disorder, and growing conflicts linked to water resources. In 1978 Colom pointed out: "Guatemalan water legislation is

comprised of a series of norms contained in a variety of laws, which has resulted in a disorganized, incomplete and incoherent water regime..." (p. 179); as part of the work report presented to SEGEPLAN-BID in 2006, Colom remarks: "... the most critical situation lies in that no institution has full responsibility for comprehensive water management, nor does a single institution centralize the granting of special usage rights or conservation measures" (p. 11); and in 2011, Aragón pointed out: "Despite having regulations for water management, the main limitation to comprehensive management of the resource is that there is no one authority to administrate it" (p. 22, Aragón, 2011) (Colom, 1978 and 2013).

Civil regulations define a general system to grant and recognize water rights⁴⁹ that is not applied; there is an absence of a national system that registers uses and rights. Therefore, the water use rights for energy and mining granted by MEM (in accordance with the General Electricity Law⁵⁰ and the Mining Law)⁵¹ are reasons for recurrent conflict among users, between users and the local population, and between the population and the State. This is due to the lack of harmonization of sectoral policies that, moreover, do not follow a national development policy, nor do they harmonize with the policies of other sectors, such as, rural development.

To overcome the conflicts that originate from energy and mining rights granted by MEM, that are based on sectoral and single use perspectives, requires the coordination of policies between MARN,

46 The 35 municipal plans and the three departmental plans, along with territories in the Samala River Watershed can be consulted here: http://www.segeplan.gob.gt/2.0/index.php?option=com_k2&view=itemlist&layout=category&task=category&id=1&Itemid=333

47 K'atun considers governmental policies posed in the past, among these, the National Water Policy and its strategy, the Policy for the Comprehensive Management of Marine-Coastal Zones, the Wetlands Policy, the National Climate Change Policy and the Irrigation Promotion Policy.

48 Some rural water committees and the 48 districts of Totonicapán, submit the water conflicts for the consideration of community assemblies; other authorities act as mediators, such as the Human Rights Office, the National Dialogue System and the Pastoral Social of the Catholic Church.

49 Part of the Civil Code currently in force, Legislative Decree 1932, in force due to transitory article 124 of the Civil Code Decree Law 163.

50 Congressional Decree 93-96 of October 16, 1996.

51 Congressional Decree 48-97 of June 11, 1997.

MSPAS, and MEM through the National Planning System (SNP) and the decisions of the Council of Ministers chaired by the President of the Republic. The SNP articulates national policies with sectoral policies and harmonizes them with territorial policies. It also coordinates planning and budgets based on multi-level objectives, as described in Figure 1.

In accordance with the Law for the Protection of the Environment and Natural Resources⁵², the Executive Branch has submitted environmental regulations, including the Regulation for Environmental Evaluation, Control and Follow-up (EIA)⁵³ that allows individual provisions to be defined for the operational exercise of activities that affect water, and the Regulation for Discharge and Reuse of Waste Waters and Sludge Disposal⁵⁴ to control water quality.

Since the issuance in 1986 of the Law on Environmental Protection and Improvement, the Executive

Branch has yet to establish technical norms and/or regulations for the environmental administration of water that take into account the management of water in watersheds; the evaluation of physical, chemical and biological characteristics and potential use of waters; the adoption of water management measures in accordance with climate change adaptation; and the regulation of good practices; as well promoting and fostering research on internal, coastal and oceanic waters that are part of the maritime economic zone.

Orantes (2011) points out: “probably the legal obstacle of most weight or that most determines the current effectiveness of the MARN [...] is the legal discrepancy between levels of responsibility and levels of control [...] Equally notable is the lack of ability to enforce current regulations. Here we refer to the Regulations on Discharge of Waste Waters, the Regulations for Environmental Evaluation, Control and Follow-up, and the chapter on

infringements and penalties of the Environmental Law.” This, together with the lack of institutionalization of government policies, the low institutional hierarchy within the ministry of the Water Resources and Watersheds Unit of the MARN (URHC⁵⁵ for its acronym in Spanish), the limited budget (which for the 2008-2011 period represents, on average, 4% of the ministerial budget) (ibid), the poor coordination between the Office and the URHC, and between these and the other ministries and secretariats, inhibit internal and sectoral coordination at every level. To overcome this state of affairs, and until a water law is issued and the legal systems for public water and sanitation services are modernized, it will require the political will of the Executive and Legislative Branches, translated into regulatory standards and financial resources to act on water matters, in accordance with the Law of Environmental Protection and Improvement.

52 Republic Congressional Decree 68-86 of December 28, 1986.

53 Approved through governmental agreement number 60-2015, of February 25, 2015; which substituted the regulations approved by agreement number 431-2007 in 2007.

54 Approved through governmental agreement number 236-2006 on May 5, 2006.

55 Created through ministerial agreement number 239-2005, published on April 5, 2005.

Table 9. National Institutional map of functions that fall under water management

Topics	General Policies	Water Uses			
		Domestic		Agriculture	Energy
		Urban	Rural		
National Supervision	Gap	Municipality	Municipality Committees	MAGA	MEM
National Institutional System	Gap	Gap	Gap	MAGA	MEM MARN
Information	SEGEPLAN CONRED MARN, INAB, CONAP	MSPAS Municipality Councils	Municipality Councils	MAGA	MEM
Research	INSIVUMEH	Gap	Gap	MAGA	MEM
Planning	SEGEPLAN	Municipality	Municipality	MAGA	MEM
Technical and scientific consulting	CONCYT	ERIS INFOM	ERIS INFOM	CENMA	INDE
Development of water resources, regulation projects	CONRED	Gap	Gap	Gap	INDE
Assignment and protection of water rights	Gap	Gap	Gap	Gap	MEM
Violations and sanctions	Gap	MSPAS	MSPAS	MSPAS	CNE
Conflict Resolution	National Dialogue System	Councils	CONADUR Community Assembly	Community Assembly	MEM
Public Services supervision	MSPAS	MSPAS	MSPAS	Gap	MEM
Public Services regulation	Municipality	Municipality	Municipality	Gap	CNE
Watershed Management	MARN	Gap	Gap	MAGA	MEM
Investment in Infrastructure	CIV	Municipality	Municipality	MAGA	INDE private
Adaptation to climate change	SEGEPLAN MARN	Municipality	Municipality	MAGA	MEM
Organization and participation	SCEP Development Councils	Municipality	Municipality	MAGA	Association of Private Generators
Education	MINEDUC	MARN MSPAS	MARN MSPAS	Gap	Gap
Communication	Presidency	MSPAS	MSPAS		

Source. Colom (2015) from Morán (2014).

		Environmental Management				Risk Mgmt.
Industry	Tourism	Pollution	Deterioration	Urban waste water	Rural waste water	Prevention
Gap	INGUAT	MARN	MARN	MARN, MSPAS	MARN MSPAS	CONRED
Gap	INGUAT	MARN	MARN INAB CONAP	MARN MSPAS Municipality	MARN MSPAS Municipality	CONRED
Gap	INGUAT	MARN	MARN	Municipality MARN	Municipality MARN	INSIVUMEH CONRED
Gap	Gap	Gap	Gap	Gap	Gap	INSIVUMEH CONRED
Gap	Gap	Gap	Gap	MARN	Gap	SEGEPLAN CONRED
Gap	Gap	ERIS INFOM MSPAS	INAB CONAP	ERIS INFOM MSPAS	ERIS INFOM MSPAS	INSIVUMEH
Gap	INGUAT	Not applicable	Not applicable	Not applicable	Not applicable	Not applicable
Gap	Gap	MARN	MARN	Not applicable	Not applicable	Not applicable
MSPAS	MSPAS	MARN MSPAS	MARN MSPAS	MARN MSPAS	MARN MSPAS	Courts
Gap	Gap	Courts	Gap	MARN	MARN	
MSPAS	MSPAS	MARN	MARN	MARN	MARN	
Gap	Gap	MARN	Gap	MARN	MARN	CONRED
Gap	Gap	Presidency Vice-Presidency, MARN	Presidency Vice-Presidency, MARN	MARN	MARN	CONRED
Private	Municipality Private	INFOM Municipality	CIV	INFOM Municipalities	Committees	CIV
Private	Municipalities private	MARN	MARN	MARN	MARN	CONRED
Private	Private community	MARN	MARN	MARN	MARN	CONRED
Private	INGUAT	MARN	MARN	MARN MSPAS	MARN MSPAS	CONRED
						CONRED

The Forestry Law⁵⁶ and the Law on Protected Areas⁵⁷, with their special institutions, indirectly promote the conservation of water; the first through economic incentives for reforestation and forest protection in areas of water recharge; and the second, because protected areas comprise more than 30% of the national territory, within which are numerous sources of water.

Regarding attention to climate change, in the year 1995, the State of Guatemala approved and ratified the United Nations Framework Convention on Climate Change⁵⁸; in 2009 the National Policy on Climate Change⁵⁹, which includes the IWRM approach, was adopted; in 2013 Congress issued the Framework Law to Regulate the Reduction of Vulnerability, Compulsory Adaptation to Climate Change and Mitigation of Greenhouse Gases⁶⁰, under the guidance of MARN and the direction of the Department of Natural Resources and Climate Change⁶¹,⁶². The financing mechanism established by the law is a specific fund which is in the process of being organized. As the coordinating mechanism, the law creates the National Council on Climate Change (CNCC, for its acronym in Spanish), chaired by the President of the Republic and including representatives of public, private and social organizations. However, water is not among the priority strategic plans contemplated in the law. Currently, the ministry promotes and supports

the process of formulating a "National Climate Change Plan".

At present, the entity responsible for meteorological observation, research on the state of water resources and the National Water Information System is the INSIVUMEH⁶³, under the Ministry of Communications, Infrastructure and Housing (MICIVI). INSIVUMEH fulfills its duties in a limited manner, due to, among other things, the lack of political support from the minister's office, the lack of strategic direction because the role that information plays in the development of water resources is not valued, and the historically meager budget allocated to this institute (Orantes, *ibid.*).

Under the Law of the Executive Branch⁶⁴, MICIVI was charged with formulating policies and enforcing the legal regime that governs the creation, maintenance and development of information services on meteorology, volcanology, seismology and hydrology; this provides sufficient legal basis to restructure the INSIVUMEH from a strategic orientation that includes valuing and promoting the development of the national water information system to support national planning and decision-making at all levels.

Regarding risk management, the Constitution provides for prevention and attention to public calamities, a legal term used to refer to the impacts of natural events; in accordance with the Law of the National Coordinator for the Reduction of Natural or Provoked Disasters (CONRED, for its acronym

in Spanish)⁶⁵, the National Risk Management System is organized at multiple levels: national, regional, departmental, municipal and community, by a multisectoral advisory council whose technical secretariat is INSIVUMEH.

According to the Law of the Executive Branch, the MICIVI is responsible for executing public works (design, construction, rehabilitation, maintenance and supervision), establishing the respective technical standards, subsidizing public works, and creating and participating in the management of financial mechanisms. To date, no national policy has been proposed related to the public works needed to develop water resources, and even if works such as the dredging of rivers and construction of banks is carried out, they do not attack the causes or form part of the management of the watershed, but respond to the immediate impacts of hydrometeorological phenomena in the watersheds, especially in the lower parts (which should harmonize with the objectives of K'atun 2032).

The legal regime of the subsector of potable water and sanitation is regulated by the Constitution, the Municipal Code⁶⁶ and the Health Code⁶⁷; it is characterized by decentralization of the provision of public services, the participation of numerous private and community providers and the absence of a service regulator.

In recent decades, Guatemala's potable water and sanitation subsector was the subject of multiple policies and plans that allowed for progress in the percentage of coverage, which

56 Congressional Decree 101-96 of October 31, 1996, and its reforms

57 Congressional Decree 110-96 of November 7, 1996

58 Approved by Congressional Decree 15-95 of March 15, 1995

59 Through Governmental Agreement 329-2009, of December 9, 2009

60 Through Congressional Decree 7-2013 of September 5, 2013

61 Through Governmental Agreement 50-2015, of August 4, 2015.

62 Previously, the issue was the responsibility of numerous Special Units created by the ministerial office of the MARN, with very limited resources.

63 Created through a governmental agreement in 1976; its functions were redefined through the Organic Rules of the MICIVI, Governmental Agreement 520-99.

64 Congressional Decree 114-97 of November 13, 1997.

65 Congressional Decree 109-96, of November 7, 1996

66 Congressional Decree 12-2012 of April 2, 2012

67 Congressional Decree 90-97 of October 2, 1997

reached an estimated 75.3% for water and 56% for sanitation. This advance was surpassed by the rate of population growth, since water coverage is currently 3.4% points lower⁶⁸, due, among other factors, to the dismantling of the subsectoral institutions as a result of structural adjustment measures introduced by the State of Guatemala in the late 1990s⁶⁹ and reflected, for example, in the Law of the Executive Branch Law issued in 1997 (Colom, 2013).

The Specialized Unit of the MSPAS monitors implementation of the National Policy of the Water and Sanitation Sector⁷⁰ and is in the process of building an information system on the state of the provision of services. This policy links service access and quality to health, nutrition, education, poverty and gender.

Environmental management of wastewater is the responsibility of MARN, which is governed by the Regulations on the Discharge and Reuse of Wastewater and Sludge Disposal, regarded as having very lax standards; the first compliance date, originally scheduled for 2015, has been modified to 2017. Empirical evidence indicates that in general, wastewater goes untreated and the institutional capacities to exercise control are very limited. This situation primarily affects the health and quality of life of populations that are supplied directly from natural sources and/or are living in poverty.

Throughout the country, water committees, mainly in rural and peri-urban areas, play a key role as providers of public water and sanitation. Initially, the committees emerged in the absence of a State response to demands

for access to basic services; they eventually assumed a leading role by promoting access and improvement of services and participating in investment, and users organized to fully assume the technical, administrative and financial responsibility for operation and maintenance, and even set standards and service rates.

The performance of the water committees is sometimes accompanied by deputy mayors, mostly representatives of indigenous communities; but no municipal or national records have been identified on the number, location, infrastructure, beneficiaries, etc., because the committees have not been articulated to the public administration system and their role has not been recognized or consistently supported by the central or municipal governments (Noack, 2014).

68 Data reported in the National Policy of the Potable Water and Sanitation Sector

69 Product of a policy promoted worldwide by World Bank, with the goal of reducing State responsibility. In the case of Guatemala, this affected the capacities of INFOM and MSPAS with regard to potable water; in agriculture, the promotion of irrigation and other measures was suppressed, ultimately reducing or eliminating State capacities with regard to sectoral water issues.

70 Approved by Governmental Agree 418-2013 of October 17, 2013

5.5.1. Watershed administration, Samala River case

The Samala River watershed covers an area of 1,621.26 km²; it is part of the slope that drains into the Pacific Ocean; it is estimated that 725,500⁷¹ people live in 35 municipalities in five departments (Figure 7), where Quetzaltenango, the second largest city in the country, is located, as well as the cities of Totonicapán and Retalhuleu. Under the Law of Preliminary Regionalization⁷², this watershed belongs to the VI administrative political region of the State of Guatemala, known as Southwest Region VI.

The Samala River watershed (Figure 7) does not have a specific authority responsible for land-use planning or watershed management, even though the Congress of Guatemala has issued laws to organize the environmental management of the natural and cultural resources of other watersheds.

At the end of 2008, the Regional Program for the Reduction of Vulnerability and Environmental Degradation (PREVDA⁷³, for its acronym in Spanish) formulated the Management Plan for the Upper Watershed of the Samala River (CARS) (Cedepem / Aldes, 2008). This tool was adopted by the Highlands Municipal Association (MMMA, for its acronym in Spanish), which in 2011 established the Council for Sustainable Management of the Upper Watershed of The Samala River (COMSCARS, for its acronym

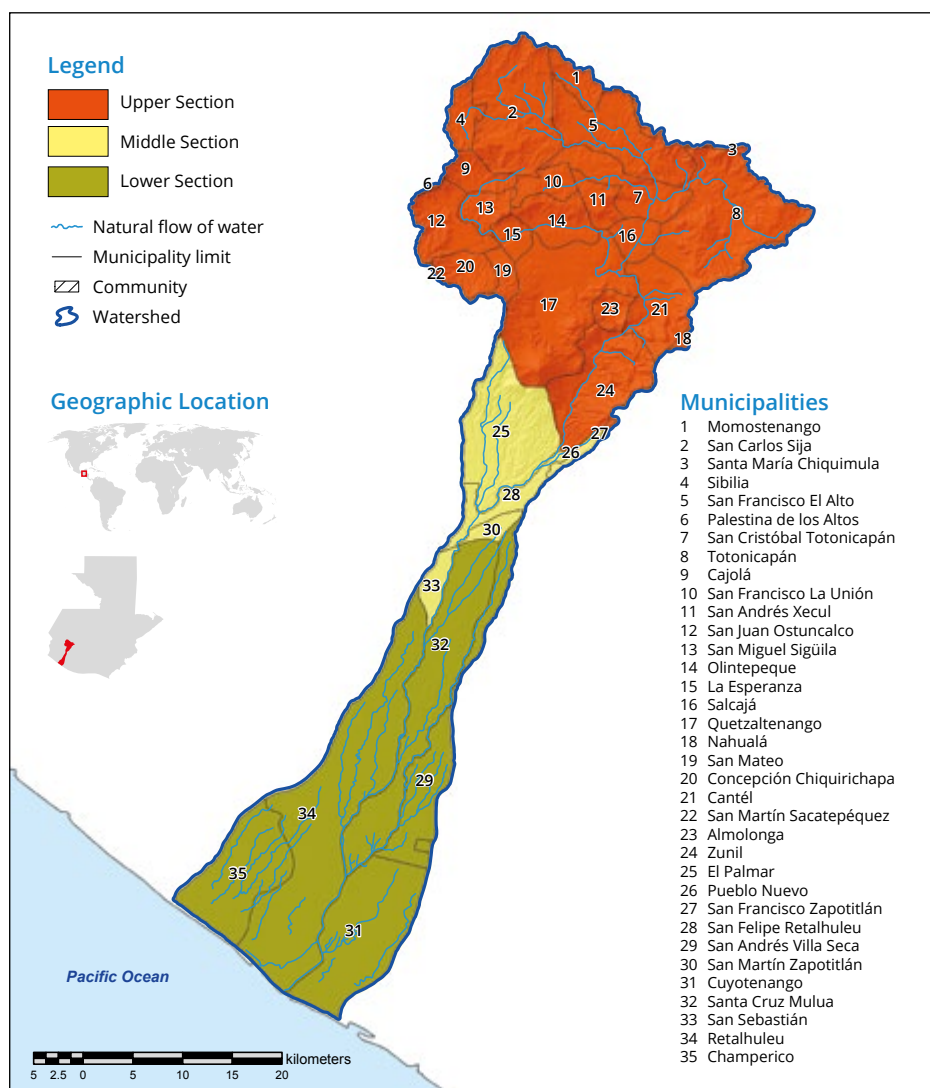


Figure 10. The Río Samala watershed and its municipalities

in Spanish), comprised of representatives from public, private and NGO entities, which through the Commission for Disaster Reduction (CRD, for its acronym in Spanish) works in coordination with the CONRED Risk Management System. The plan still lacks the necessary funding for its implementation and the council does not seem to be working (Noack, 2014).

The public actors that intervene in the Samala River watershed reflect those described in Table 1; the governing ministries do so through their departmental delegations and, in some cases, through municipal delegations and other

entities, depending on their main task. Some of the noteworthy institutions and actions on the issue of water security are described below:

In the Samala River watershed, INSIVUMEH operates three weather stations (Labor Ovalle, Santiaguito Observatory, Retalhuleu Airport), and three hydrometric stations (El Tunel, Candelaria, and Cantel); unfortunately, it appears that there are more than twenty stations out of service.

In the area of the watershed, CONRED has organized an institutional risk management system: the coordinator for Southwestern

⁷¹ Calculation made using LandScan™ with 2010 data.

⁷² Congressional Decree 70-86, of December 9, 1986.

⁷³ Program at the level of Central America that ended in 2008 and included the upper watershed of the Samala River as a pilot watershed of the State of Guatemala.

Region VI, comprised of officials from the departments of San Marcos, Quetzaltenango, Totonicapan, Solola, Retalhuleu and Suchitepequez; five departmental coordinators; 35 municipal coordinators; and numerous local coordinators.

The National Forest Institute (INAB, for its acronym in Spanish) applies the Forestry Incentives Program (PINFOR, for its acronym in Spanish) and the Forestry Incentives Program for Holders

of Small Acreages Suitable for Forestry (PINPET, for its acronym in Spanish) throughout the national territory, including the Samala River watershed. Although the number and extent of protected areas is not significant in the area of the watershed, the legal framework exists to declare such areas in order to contribute to the conservation of water sources and other proposals for specific projects in the MDP of Quetzaltenango and Santa Cruz Mulua.

It is also important to note that in the upper part of the watershed are found the 48 cantons of Totonicapan, home of the Quiche Mayas, a people recognized for their observance of a common system of rules for managing land, water and forests based on their knowledge and ancestral worldview (Box 2); these norms coexist with other social practices, both formal and informal, observed by other cultural groups throughout the watershed (Noack, 2014).

Box 2. Notes on water management by indigenous peoples⁷⁴

In the Samala River watershed, 77% of the population belongs to some indigenous group: Quiché 84.4% and Mam 15.6% (2003 data); and live mainly in rural areas (64%) (Noack, 2014). In these rural communities there are various forms of social organization and participation distinct from those commonly practiced in urban environments, designated as "traditional" (indigenous mayors, councils of elders, fraternities and partisanships), which have operated up to present times in coexistence with civil associations, foundations, associations, cooperatives, trade unions, church organizations, committees, etc. According to the interview with expert René Barreno Ixcot*: "these forms of organization have enabled communities to develop and strengthen their social fabric, maintain and recreate their customs and traditions, and solve the various kinds of problems that affect them; They have been based on respect for their cultural values, especially respect for the elderly. " The rules governing social relationships have not been imposed but developed, over time, in a differentiated dual relationship with the authoritarian State on the one hand, and with their community or municipality on the other. These are established customs and are therefore formally considered as sources of law.

A transcendental form of community organization in the western highlands of the country are the auxiliary mayorships, which, in practice, constitute the highest authority that applies the Mayan law through a government system parallel to the official municipal system. The historical foundation of power is closely linked with the spirituality of the people who govern the physical and natural environment. At the community level, says Barreno Ixcot, "Among the various responsibilities and powers that auxiliary mayors assume is that of mediating conflicts and resolving problems that arise between community members, including disputes over water, forest, land or other resources; they are intimately linked to natural resources; for example, in the month of January they have "the transfer of the stick" (symbol of authority of the auxiliary mayors), where the incomers perform the "caminamiento" [reconnaissance walk] of the boundaries of the forests and their communities, and of the springs that are in communal territory, because they will be responsible for their safekeeping".

In these territories, power is granted to individuals in relation "to the service provided during their lifetime", that is, their age. From this process arise the councils of elders or principals, a group of social opinion or coercive power which in special situations has the last word (says Barreno Ixcot).

Similarly, the Community Assembly handles decision-making practices or conflict resolution. The norms arising from these assemblies acquire the nature of law, provided that they are acknowledged as good or fair, thereby creating community institutionalism.

* René Estuardo Ixcot, Economist, Expert on Indigenous and Water Issues

5.5.2. Pilot municipalities

5.5.2.1. Santa Cruz Muluá, Guatemala

Almost bordering on the Pacific Ocean, Santa Cruz Muluá has an area of 128 km² with approximately 12,731 inhabitants, mostly living in rural areas (77%)⁷⁵. Poverty stands at 65% and the illiteracy rate is 13%. The municipal diagnosis of the MDP mentions a school drop-out problem, and in a study on drinking water in Guatemala (Lentini, 2010), the drop-out rate is related to the lack of basic services such as water. Regarding ethnicity, it is reported that 71.9% of the population is Ladino, followed by the K'iche ethnic group with 21%. Other groups are the Xinka (4.5%), the Kaqchiquel (0.6%) and the Mam (0.5%).

Water sources

The municipality has only 0.01% of any type of forest (Smith, 2015) and few existing land management guidelines, and even fewer are being implemented that favor conservation of water sources.

The watershed has a water production (total of surface runoff, lateral flow and base flow) of 524 mm, which is equivalent to 1,171 m³/person/year (Smith, *ibid.*). This places it near the shortage level (which is reached at 1000m³, UNESCO-WWAP, 2015). Being located south of the Samalá river, the municipality of Santa Cruz Muluá receives a significant amount of domestic, agricultural and industrial waste from tanneries and clothing and textile laundries, so groundwater is the main source of water supply for the population and irrigation.

In general, conservation of water resources has not received the necessary attention; further research is needed, as well as the personnel, resources and partnerships that enable the implementation of research and conservation projects.

Water and development

Agriculture is the main economic activity and source of income and employment (mainly informal and temporary subsistence jobs), as well as the largest user of water in the municipality. Other users are the livestock and hospitality sectors. Within agriculture, the most widespread crop is sugar cane, which depends on irrigation.

Concern was expressed in the workshops over the fact that the water sources used for irrigation are impacting the availability of water for the community, and over the contaminants being released into the rivers by the mills. Addressing this concern requires monitoring water sources, increased dissemination of information, environmental education and programs for efficient water use for all users.

Food security

Although the main economic activity in the municipality is agriculture and 69% of the people are occupied in planting basic grains and backyard production of chickens, pigs, turkeys and cattle, the latest statistics available show that in 2008, 855 women (9.5% of disease cases) and 231 men (4.9%) were treated for malnutrition in the municipality; stunted growth in children under 5 years of age is moderate, at 34.6%, while 7% present severe stunting (COMUDE Santa Cruz Muluá, 2010). This paradox occurs because the main

productive activity is based on crops such as rubber, fruit and sugar cane, rather than crops for local consumption (*ibid.*).

Health

The health statistics available for Santa Cruz Muluá speak of a high incidence of water-related diseases (parasites, respiratory infections), where children are particularly vulnerable (MDP COMUDE Santa Cruz Muluá, 2010). In addition, stunted growth in over 40% of first graders is reported⁷⁶, which can be attributed to malnutrition.

An analysis of Guatemala presented by the IDB⁷⁷ states that "following birth, children, particularly those from the poorest families, are subject to very poor breastfeeding practices and complementary feeding. Infections, especially diarrhea resulting from poor hygiene and contaminated drinking water, reduce both appetite and nutrient absorption. These two factors combined, inadequate diet and infections, are the main causes of chronic child malnutrition in Guatemala".

Potable water

The statistics reveal that water service in Santa Cruz Muluá has historically been poor (the MDP mentioned that the municipality provides potable water, mainly through wells, to 55% of households, covering 90% of the urban area and 60% of rural areas, COMUDE Santa Cruz Muluá, 2010).

75 Population estimates for the year 2010 (COMUDE Santa Cruz Muluá, 2010)

76 SESAN (Secretariat for Food and Nutritional Security) and the Ministry of Education (COMUDE Santa Cruz Muluá, 2010)

77 <http://www.iadb.org/es/temas/salud/desnutricion-en-guatemala,3866.html>

However, during the present study, an evaluation was made of the progress achieved by the Office of Planning during the last municipal administration under the leadership of Mayor Mario Jerome Rivera, who spoke about the efforts made in recent years:

"From the beginning of my administration [nine years ago] work has been done with the Municipal Development Plan and Development Council, specifically reviewing investment projects. Since 2008, the investment budget for the municipality has risen from 1.5 million to 7.5 million Quetzales, of which approximately 60% has been earmarked for potable water projects. Other investment themes have been education, roads, etc. Among the water projects carried out are: construction of wells, elevated storage tanks, chlorination and conduction systems and replacement of asbestos piping.

The investment mechanisms follow the procedures established by the General Secretariat of Planning. First, the projects are developed in the Office of Municipal Finance and Planning; next, they pass through the development entities (COCODEs, COMUDES and CODEDES); finally, they are put up for bidding, awarded and monitored.

The Maintenance Office responsible for the operation of water systems in the municipality has a brigade of plumbers, some with permanent contracts and others with temporary contracts of two or three months to give employment opportunities to the local population. Their training is on the job since the tasks are simple. When major repairs are needed, such as changing pumps or electrical system failures, external personnel are hired through procurement processes. Normally

there is one person operating each of the systems. That is to say, employment opportunities in the municipality have increased, with the assignment of jobs such as cleaning, sweeping, repairing leaks, repairs in schools, etc., although the aspect of supervision is critical and I myself often have to supervise. [It should be noted that the issue of specialized personnel and job security was one of the most frequently mentioned weaknesses in participatory exercises].

Houses do not have water meters; to install them, another project would be required. This is how the systems have been built in the city; the different stages of the systems have been completed step by step through projects. Gradually, the user databases have been updated and the system for collecting service fees has improved. Now the municipality charges between Q10.00 and Q15.00 [from 1 to 2 USD] a month for water service.

As for chlorination, this has not had full public acceptance. Tablets or granules have been used, but their implementation, monitoring and recording have not been entirely systematic. From time to time, the Ministry of Health performs analyses and cleans the wells. We think the water quality is good. In the past there were even worms in the water, but now quality problems have greatly diminished.

As for budgets, they are based on expected revenues. These budgets have increased with the large percentage of collections, but there are still arrears. "

Among the greatest challenges discussed during the municipal participatory workshops were the issue of resources to extend service networks to more communities (basically consisting of small

networks supplied by wells), more equipment and maintenance, more staff with adequate working conditions and improvement or standardization of processes and controls.

Sanitation

Sanitation is handled by the Department of Water and Drainage. According to the MDP, of the 1300 houses located in urban areas, 800 (63%) are connected to drainage systems. In rural areas there are 170 "candelas domiciliarias"⁷⁸ for approximately 400 homes, representing 53% coverage. The rest of the households dump their wastewater into roadside ditches or gullies and nearby rivers.

In the municipality, sewer systems are not prioritized (according to the mayor) and discharge flows directly into the Samala River. Currently, there is a charge for water service and drainage, but this is not channeled into improving this service. In order for the municipality to provide wastewater treatment, land is required to locate a plant.

Management of solid and hazardous waste

Solid waste is collected by private companies contracted by individuals; the municipality does not offer this service and does not have a controlled system for waste disposal. In rural areas, most people burn their garbage, others prefer to bury it or throw it in vacant lots (communication with the mayor).

⁷⁸ A register or box installed in the entrance to the property, where black and grey waters come together, then enter a pipe connected to the main collector. This register can be opened by the municipality for inspections.

Energy security

In urban areas, 100% of households have access to electricity; in rural areas, 90%. The MDP states that some extremely poor families cannot afford electricity, so firewood is a common source of energy in homes.

Risks

As for the risk of disasters, the city is prone to frequent flooding; its proximity to the ocean exposes it to frequent hurricanes. The National Coordinator for Disaster Reduction (CONRED) warns that the communities of the municipality suffer from the overflow of the Samala River during the rainy season.

Among the communities most affected by floods, overflowing rivers and lahars are the cantons of Siglo I and II and Petencito; overflowing rivers mainly affect the lower part of the municipality, in areas such as San Antonio el Mangal, Labor Casa Blanca, La Lolita, San Antonio Boxoma and Santa Lucia; the community of Brillantes also suffers from overflowing rivers, causing closure of the road "La vuelta al Niño". The assets affected by the flooding include schools, roads, bridges and agricultural production systems.

The risk of drought is classified as having a high rate of occurrence (Smith, *ibid.*) and affects non-irrigated farming systems (the poorest) in communities such as San Antonio el Mangal, Labor Casa Blanca, Microparcelamiento La Lolita, San Antonio Boxoma, Santa Lucia and the canton of El Asintal. It also affects crops that use gravity irrigation systems throughout the entire municipality.

Landslides occur due to soil degradation and loss, especially on the

banks of the Samala River (Smith, *ibid.*).

Drought is also classified with a high rate of occurrence (Smith, *ibid.*) and affects the unirrigated farming systems that usually belong to the poorest people (COMUDE Santa Cruz Mulua, *ibid.*).

The municipal seat has a good density of roads that are open all year long, as well as vehicle and pedestrian bridges. In rural areas, most roads are unpaved and deteriorate in the rainy season, leaving communities in the south isolated. It was expressed during the workshops that due to lack of maintenance, some concrete bridges are in poor condition from the impact of heavy rains and the swollen rivers that have undermined the banks, and need to be reinforced to extend their life. In general, there are good systems of mass communication, where radio stations (FM and AM) represent an excellent means of communication among communities; there is also extensive mobile phone coverage.

In response to constant natural hazards, the municipality has a community alert system in various communities around the Samala watershed. According to information from the community, the system has helped prepare people to some extent; however, greater follow-up on the municipal disaster plan by CONRED is lacking; there is no commission for the municipality, or sufficient staff trained to deal with emergencies and comprehensive risk management.

Governance

Currently, there is strong leadership in the decision-making structure, thanks to the excellent work of the Office of Municipal Planning. The communities have been able to manage their own development projects through personnel qualified in project formulation and evaluation. It is commented that strengthening is needed with respect to equipment, as well as greater follow-up on the implementation of the actions referred to in the MDP. At the same time, management through the sixteen existing community development councils represents a strength, and their empowerment provides an opportunity to carry out the planned projects.

The opportunities for municipal management that were identified - better communication and coordination between divisions and regulations, systematization of the legal documents on municipal property, strengthening of the Environmental Commission in the municipality, a system of information or review of achievements, and strengthening the role of national institutions in the municipality - may be present, but their impact, particularly with regard to water, needs to be made known.

Among the strengths of local governance are: the existence of the Municipal Code and Health Code and other regulations on municipal services and arrangements for decision making and conflict resolution. However, there is difficulty discussing the impact of irrigation in the communities. As elsewhere throughout the country, there is no recognition of water rights for non-derivative and customary use. Moreover, the absence of a legal department in the municipality with knowledge of the rights and obligations concerning water

issues, and the lack of a water law (a weakness mentioned in all aspects of water security), impede the resolution of conflicts. More education and greater environmental awareness among the population were pointed out as an alternative for preventing such problems.

Summary assessment of water security indicators

Water security was assessed using 30 indicators related to the eight issues into which the concept was divided. On a scale of 0 to 100, Santa Cruz Mulua received a rating of 68. In Figure 11 the overall performance of the municipality can be seen. The number inside the bars refers to the number of indicators with that rating. As can be observed, the biggest problem relates to the availability and quality of water sources.

5.5.2.2. Quetzaltenango, Guatemala

Quetzaltenango, the second largest city in Guatemala, is located in the upper part of the Samala watershed; it has 20 communities and a projection of 145,637 inhabitants⁷⁹; Spanish is spoken and the predominant indigenous language is Quiche. Services are economic drivers of Quetzaltenango, predominantly in education and health, as well as restaurants, hotels, transportation and recreation, among others. The main sources of employment, however, are agriculture, hunting, forestry and fishing (53% of the economically active population); 13% is dedicated to the manufacturing, textile and food industries; 10% to trade, restaurants and hotels; 7% to professional services (COMUDE Quetzaltenango and DPT SEGEPLAN, 2010). Therefore, the municipality has a high level of immigration of people who come seeking better education, health or employment. This will be an important factor in all issues of water security as will be seen later.

Potable water

Water management in this municipality is interesting. The municipality has been consistently making progress in implementing management actions for its resources in general. One advance that stands out is the municipal potable water company, which has gradually matured, in part due to the support of international cooperation (Austria, Japan, Italy, Spain, Colombia and Canada, on issues such as water, risks and land-use planning), but mostly due to the technical commitment of the officials in charge. Below is a brief

overview of this process⁸⁰:

In 1997 the City Council approved the Xelagua project, through Austrian cooperation and the efforts of a team of international and national consultants who finished preparing the "Master Plan for the Supply of Potable Water to the City of Quetzaltenango", which among its recommendations called for the formation of a public water utility. Thus, in 2001 the Xelaju Municipal Water Company (EMAX, for its acronym in Spanish) was formed. Then, in order to implement the finished plan, embassies and aid agencies were approached and Japan's cooperation was secured, thereby initiating another strengthening process.

After adjusting the plans and designs, infrastructure was built and personnel were trained in the maintenance and operation of the different systems. Three years after project completion, the personal and professional quality of the technicians in charge of the company garnered an "A" rating in the post-project evaluation, a rating never before achieved for a project in Central America. The constant desire to learn and share information was seen as a strength that allowed them to advance on solid ground and improve on the plans already established. For example, the Strategic Plan and Manual of Operations and Procedures, prepared by an external organization, is gradually being improved, and the weekly meetings of the department heads for planning and decision-making have been of great benefit.

The official statistics (COMUDE Quetzaltenango and DPT SEGEPLAN, *ibid.*) shows that 96.3% of households have access

79 Population projection for 2009.

80 Based on personal communications with EMAS directors and technicians and other municipal officers.

to improved water sources. The company directors who were interviewed tell a story of evolution: they recognize that initially, the priority was the development of infrastructure and supplying water in adequate quantity and quality to the urban population. They are currently promoting projects for rural areas, chlorination systems and renovation of pipelines (some equipment is already obsolete and in some places the network is very old); they are also contemplating projects for watershed protection with other municipalities, however, their approach to other municipalities has been a great challenge, as will be explained later.

Regarding water quality, the company has a laboratory for physical, chemical and bacteriological tests of all wells and water sources. For example, residual

chlorine is measured every day at different times in various parts of the system; reports on the results are delivered to the directors each month. Chlorination is also performed in rural water systems, but it has been observed that people are less accepting of the taste of chlorinated water.

Recently, the scale of rates charged by EMAX was modified, associating the consumption level and type of use (residential, commercial and industrial); The legislation provides a subsidy of 5 m3 to residential users who consume less than 15 m3. This new fee schedule appears to have contributed to a more efficient use of water by the population. It should be noted that this regulation only applies to the municipal company, but not to other companies that provide water service in small areas and

which will be discussed later. Promoting efficient use of water is being taken seriously in the municipality, driven by the gradual decline in groundwater levels in aquifers. Therefore, there is great interest in learning about experiences with efficient technologies, especially in production and industrial processes.

Micromasuring is 100% present in the urban area and EMAX has improved its reading, billing and collection systems. They aim to reduce the percentage of unaccounted-for water, which is currently 63%. To this end, they have tested a reading system through a cellular application that reduces errors and facilitates information capture, a project financed by the IDB.

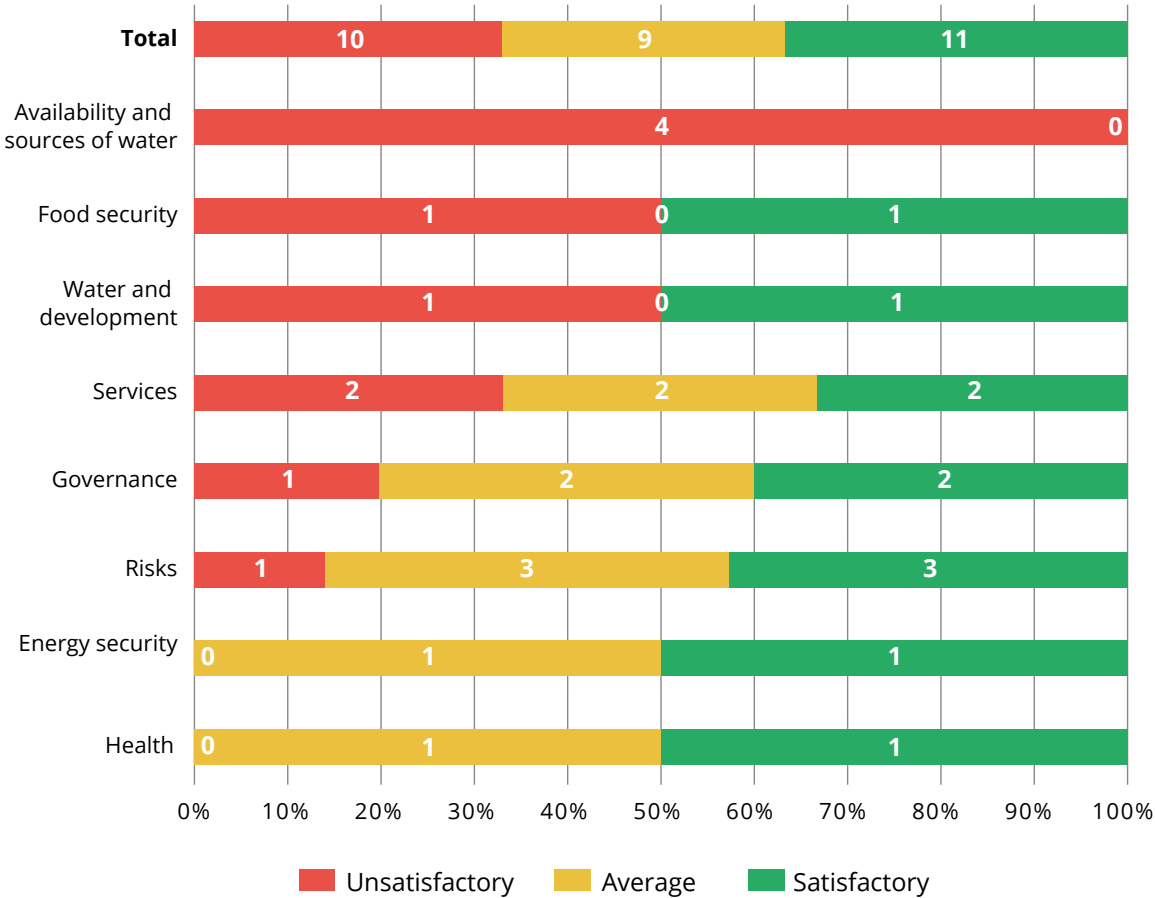


Figure 11. Water security in Santa Cruz Mulua

The budget of EMAX is based on fundraising plans which are often surpassed, generating surpluses. However, they cannot access these funds because the company applies the ordinary processes of procurement, contracting and bidding, which are subject to the decisions of the City Council. It should be noted that the service fee paid by the water user does not include the high cost of energy, which is covered by the municipality through its own power plant. In other words, the municipality partially subsidizes water service, an argument which justifies the municipality's access to the company's economic surpluses. This situation distorts the structure of rates and limits the independence of the company and its ability to expand coverage and service quality.

Among the company's vulnerabilities - also associated with its relationship to the municipality - is the issue of staff: on the one hand, the designated personnel do not meet the profile required for the positions, and on the other hand, the vacancies that are left (by retirements and resignations) are not filled; the conditions of stability and remuneration also need to be improved for some members.

According to the director, to date, the Master Water Plan has reached an implementation level of 45%, and is expected to reach 47% in 2018, with the main obstacle being the lack of funding to cover the projects. He therefore stresses the need to analyze the company's dependence on the City Council and to have access to their own resources for reinvestment in a more efficient service.

This issue is not trivial. Because of the difficulty in accessing more funds, EMAX does not respond with the agility demanded by urban growth, giving rise to private alternatives that provide water services without the necessary regula-

tions governing quality and price or control over the digging and operation of wells. The Housing Development Control Unit, through its technical urban planning group, evaluates the design of basic services; however, more monitoring is needed.

Sanitation

The MDP statistics (COMUDE Quetzaltenango and DPT SEGEPLAN, *ibid.*) reveal that 96% of households in the municipality have improved sanitation facilities, although there is no treatment of wastewater. Wastewater drainage is handled by the Municipal Sewer and Drainage Department (DDA, for its acronym in Spanish); although a Master Sewer Plan exists, its implementation is limited primarily by the lack of financial resources.

Just recently, the rate for drainage service was updated with a fixed monthly fee that depends on the type of installation (housing, commercial or industrial). This measure is expected to improve the service and finance a wastewater treatment plant; currently, raw sewage is dumped directly into the Samala River. Starting in 2002, new housing developments must have some kind of wastewater treatment and absorption wells for rainwater, designed for a return period of 20 years, as a flood control measure.

Risks

Flooding has increased in frequency and magnitude due to a number of factors, such as: poor compliance with zoning laws, with buildings and settlements located in vulnerable areas; development that has not been oriented by any governing body in terms of location, construction or operation practices (for economic activities or housing developments) to ensure

implementation of risk prevention measures; clogging of drains by garbage, which occurs mainly in areas close to markets; and finally, development and waterproofing of surfaces in the municipalities of the upper watershed, specifically La Esperanza and San Mateo.

CATHALAC's assessment (Smith, *ibid.*) found Quetzaltenango to have a high exposure to flooding. The population living in flood risk areas is principally located in the metropolitan area and in rural area of Palajunoj. An unfortunate event with lasting consequences was the flooding of the Xequijel River, which contaminated wells that provide the city with water. Heavy rains also affect water systems due to power outages.

CATHALAC's assessment (Smith, *ibid.*) also found Quetzaltenango to have a high exposure to landslides. Members of the FGs indicate that the incidence of landslides has increased due to forest degradation and alteration of urban plans. Citing significant landslides events, the MDP mentioned Candelaria and Cerro La Pedrera, which affected Avenida El Cenizal, Barrio San Bartolome, Barrio Bolivar, Avenida 9, etc.

As for the risk of drought, even though the city does not have a high level of exposure (Smith, *ibid.*), it was reported in the MDP that basic grains are often the most susceptible crops and that private and public drinking water systems which they are supplied from wells often have service outages during the dry season.

Finally, the risk of frost was evaluated, resulting in a rating of low exposure for the municipality (Smith, *ibid.*). Again, basic grain crops are the most vulnerable to losses from frost and hail, which weaken them and make them more prone to pests and disease.

Community disaster organization is promoted by CONRED (the acronym in Spanish for the National Coordinator for Disaster Reduction) at the national level. At the municipal level, a COMRED and COLREDS were formed to work with the Municipal Coordinator, but have not yet been consolidated. In 2014, the municipality created the Municipal Plan for Immediate Emergency Response for the Municipality of Quetzaltenango, which describes the actors, responsibilities and necessary actions in case of landslides, floods, earthquakes and water shortages due to emergencies, among others. At present, a response is made only in the event of a disaster.

Regarding funding, there is a municipal fund for emergency issues, but due to bureaucracy the fund is not implemented immediately, as these cases require. Part of the basic response equipment has been acquired through donations, however, funds are lacking to acquire more equipment, replace damaged equipment and generally, to implement plans and projects that have been formulated.

Although the COLREDS manage to survive through volunteers and community groups, greater participation by other entities, in the private sector for example, is required.

Management of solid and hazardous waste

Solid waste collection in Quetzaltenango is provided primarily by the municipality's Department of Environmental Services. The departmental statistics show that service coverage is 91% in urban areas and 2.5% in rural areas (the MDP talks about 100% coverage in urban areas). The municipal Director estimates that

in rural areas especially, most trash is burned or buried. The municipality does not have an appropriate area for the disposal of domestic, hazardous and medical waste, which in the end also affects the quality of the Samala River.

Water sources

The municipality has some sort of forest cover over 25% of its area (Smith, *ibid.*), and implements the Management Plan for the Saq Be' Regional Park through the Department of Environmental Services. According to department officials, the involvement of surrounding communities needs to be promoted, partly because of the opportunities to develop ecotourism projects there, as well as to halt the advance of the agricultural frontier.

As mentioned in section III, the Samala River watershed has a water production of 524 mm, equivalent to 1,171 m³/person/year (Smith, *ibid.*). This places the watershed on a level close to water scarcity (i.e., when it reaches 1000m³, UNESCO-WWAP, *ibid.*). The surface water is highly contaminated, particularly due to domestic discharge and agricultural and industrial residues (textiles, tanneries, beverages).

Thus, the main water source used by the population comes from underground by means of 27 wells, covering 76% of the supply, and 16 springs of surface water (infiltration galleries) located in the municipalities of Esperanza, San Miguel Sigüila and San Juan Ostuncalco, which supply the remaining 24%⁸¹.

Private services that provide water in housing units are supplied from private wells (85 at the time of the evaluation) and in rural areas,

committees or associations are also supplied for the most part by wells and some springs.

There is some concern on the part of the management of the municipal company over water availability. Projections of increased water demand indicate that the aquifer's maximum capacity will be reached in 10 years, a serious situation considering that surface water is scarce and contaminated.

Since it is known that the use of water saving technologies is limited⁸², systematic efforts are currently being made to: a) promote awareness and education for the most efficient use of the resource; b) promote the creation of municipal regulations requiring proper use of the resource; c) develop watershed protection actions.

In relation to the watershed, the municipality of Quetzaltenango has purchased the areas around the springs located in neighboring municipalities, but there are some difficulties. Although the Regional Urban Development Plan indicates that the Xequijel River should be protected to a distance of 50 m, allowing only agricultural activities, the presence of homes, sand extraction activities and roads over the pipelines threaten the integrity of the sources. The municipality has reported these incidents to the Public Ministry, but it is feared that easements will be affected. In addition, negotiations are complicated by the large number of owners of land near the intakes, the vagueness of the municipal boundaries and the population's perception that "water that is increasingly scarce is being carried away."

81 Data provided by EMAX

82 Some sustainable indigenous practices applied in local agriculture are systematized in The Nature Conservancy (2015).

The possibilities for Quetzaltenango to invest in another municipality are restricted by the Comptroller General, which highlights the importance of strengthening the role and the authority of the already existing Highlands Municipal Association, composed of the municipalities of Quetzaltenango, Salcaja, La Esperanza, Zunil, Sibilia, San Mateo, Olinstepeque, San Carlos Sija, San Andres Xecul, Totonicapan and San Juan Ostuncalco. Moreover, there are management provisions that have been implemented through the PREVDA project, but formal mechanisms for implementation are lacking.

Another possibility being explored by EMAX is the development of a system of payment for environmental services with the participation of the private beverage industries of Quetzaltenango.

Governance

There are several conflicts over water in the municipality of Quetzaltenango. One of them refers to the relationship with other municipalities in the upper watershed, affecting water intakes and the protection of microwatersheds; another relates to contamination of sources by land use and solid and liquid waste, as well as problems with flooding.

A third conflict has to do with private water service provision, which is authorized through the intervention of residents and involves decisions that do not benefit the system in general, overreaching the functions of residents that are laid out in the Development Councils Act. Consequently, there are service providers that do not comply with water quality conditions and price controls. Another source of stress

is the lack of regulation in water use and compliance with land use planning.

In the organizational aspect, the COCODEs have around 103 organizations for eleven urban areas, with a COCODE for each community (MDP) in rural areas. With regard to gender, there is little participation by women in either the COCODEs or the COMUDE. In the FGs it was noted that these committees sometimes become linked to specific projects, setting aside their reason for being, and therefore require strengthening and adequate legal advice. Often, the situation leans towards the other extreme, leaving the responsibility for issues entirely up to the communities.

The commitments on the issue of transparency and governance have not been formalized, so information is scattered and does not have an impact on decision making.

The municipality is not equipped to respond to intermunicipal disputes or lawsuits from private entities with legal counsel. Municipal management, the office of legal counsel and EMAX have, in general terms, solved problems of water governance, but a law is needed to order all water management, describe the responsibilities and scope of participation at all levels, and to promote the watershed management approach for the management of various water security issues.

Health

Among the chief causes of morbidity in men and women are intestinal parasites; in children, the chief causes in addition to parasites are diarrhea and anemia. This is related to water quality and the overall environmental quality of the watershed. However, this issue was

not a concern in household surveys (Alvarado et al, *ibid.*). The issue of health is not the direct responsibility of the municipality but rather of the national government, so the municipality does not consider it a priority, and to address it would require strengthening.

Food security

Basic grains and horticulture form the bulk of the municipality's agricultural production. In relation to malnutrition and stunted growth, for 2008, according to the health center (MSPAS, 2008 in COMUDE Quetzaltenango and DPT SEGEPLAN, *ibid.*), 292 children under the age of 5 were treated for malnutrition; protein-energy malnutrition is among the leading causes of male mortality; and stunting stands at 36.5%, of which 4.6% represents severe cases (*ibid.*).

Energy security

According to the MDP, 25178 households (74%) have electric service through the network; only 67 houses use solar panels, 57 use regular gas, 1205 use candles and 9 homes use another energy source.

Summary of the evaluation of water security indicators

Water security was assessed using 28 indicators related to the eight issues into which the concept was divided. On a scale of 0 to 100, Quetzaltenango received a rating of 68. In Figure 12 the overall performance of the municipality is shown; the number inside the bars refers to the number of indicators with that rating; it can be observed that the lowest performers are governance and risks.

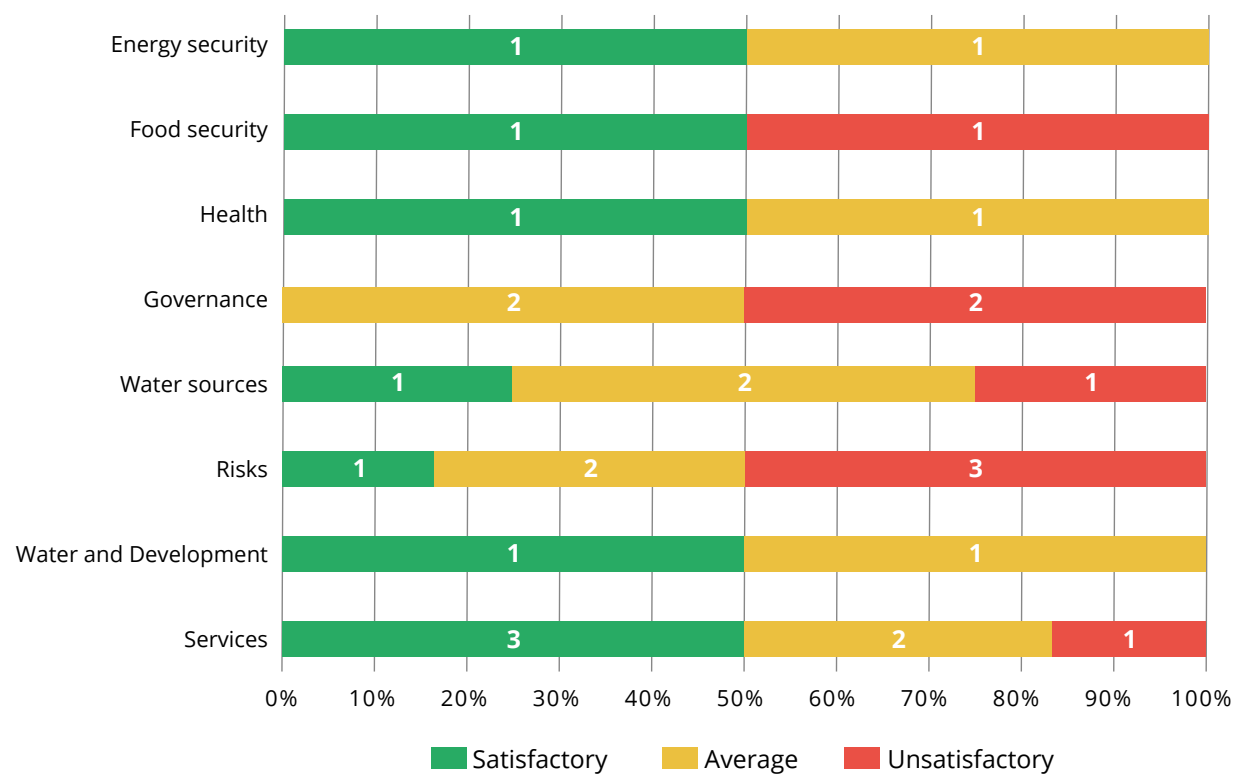


Figure 12. Water security in Quetzaltenango

5.6. Summary of adaptation measures by municipality

As can be seen in the following tables, in the municipalities of Guatemala, priority was given to "soft" investments, while in the Dominican Republic, "hard" investments. i.e., infrastructure, prevailed. All of the adaptation measures identified by the municipalities are listed in Annex 2.

5.6.1. Guayabal, Dominican Republic

In Guayabal, 17 adaptation measures were identified that address not only the issue of water sources, but also the subject of services, water and development. Table 11 provides a count of the measures identified to address water security in this municipality. It is positive sign that there are measures addressing supply and demand for water, as well as some to strengthen management capabilities. No measures related to structural aspects, such as legal or institutional structures, were identified.

Table 10. Summary of adaptation measures for Guayabal

	Services	Water and Development	Water sources	Total
Supply				
Watersheds			4	4
Infrastructure	3	2		5
Demand			6	6
Capacities	1		1	2

5.6.2. Tamayo, Dominican Republic

In Tamayo, 30 adaptation measures were identified that address the five priority issues. Table 12 provides a count of the measures identified to address water security in this municipality. The balance between measures addressing supply and demand for water and those for institutional strengthening is very positive. No measures related to structural aspects, such as legal or institutional structures, were identified.

Table 11. Summary of adaptation measures for Tamayo

	Supply				
	Watersheds	Infrastructure	Demand	Capacities	Total
WATER SOURCES	3		3	1	7
SERVICES		7	1	1	9
WATER USE AND DEVELOPMENT		2	1	3	6
RISKS	1	2		5	8
TOTAL	4	11	5	10	30

5.6.3. Santa Cruz Mulua, Guatemala

In Santa Cruz Mulua, Guatemala, of the 30 measures identified (Table 13), most refer to strengthening management capabilities; no recommendations were given with regard to areas outside the scope of the municipality, for example in relation to the legal framework or the distribution of institutional responsibilities. It is imperative to continue balancing supply-related measures with the demand in each area.

Noteworthy are the few initiatives related to "hard investments" such as infrastructure. Most actions are for the short term and none were considered for the long term, since difficulty in planning for this time frame is natural.

Table 12. Number of adaptation measures by prioritized water security element

<i>Tipo de medidas</i>	TERM			Sources	Services	Governance	Water and Development	Risks	Total
	Short	Medium	Long						
Strengthening of capacities	11	6		2	7	4	1	3	17
Supply management	2	1		1	2				3
Demand management	3	6		3			5	1	9
Participation	1					1			1
Legal framework									
Total	17	13	0	6	9	5	6	4	30

5.6.4. Quetzaltenango, Guatemala

In Quetzaltenango, a good balance has been achieved in the adaptation measures for different areas of Integrated Water Resources Management (CATHALAC, *ibid.*). Few initiatives related to "hard investments" were suggested, which is attributed to the progress made in the past in this area. Most actions are for the short term (Table 13 and Table 14).

Table 13. Number of adaptation measures by prioritized water security element

Water security issue	Sources	Risks	Services	Governance	Health	Water and development	Total
Number of measures	7	4	13	11	5	8	48

Table 14. Balance of adaptation measures in Integrated Water Resources Management

CATEGORY	Total	Term	
		S	M
Legal/institutional framework	9	5	4
Spaces for participation	6	6	
Strengthening of capacities	10	4	6
Management of watershed and water sources	5	4	1
Infrastructure	4	2	2
Risk management	5	4	1
Demand management	9	9	
TOTAL	48	34	14

The Rio Samala watershed, Guatemala



The Rio Samala watershed, Guatemala

6. Conclusions and Recommendations

6.1. Water security, IWRM, and rule of law

Water security should be adopted as the ultimate goal of water management and governance, based on the definition provided by UN-Water, understood as "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"(UN Water, 2013).

Water security should be adopted as the ultimate goal of water management and governance, based on the definition provided by UN-Water, understood as "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"(UN Water, 2013).

This concept is valuable because: a) it refers to a continuous process of development of capabilities, b) highlights the result at the local level, d) links biophysical and social aspects, e) integrates the concept of risk, f) refers to the various competitive water uses, g) highlights the importance of maintaining peace and political stability, and h) is associated with other concepts such as food security and energy security.

While the concept of water security is suitable for making comparisons and performance analyses, we must pay attention to the weighting of variables to properly judge different performances. In any event, it is preferable to find adequate levels of water security for each population, through goals constructed in a participatory manner.

With the understanding that no amount of water will be enough to supply a disorderly, inefficient or excluding demand, CATHALAC proposes that to achieve water security, joint management between the various institutions

(sectoral and non-sectoral) and society is needed; that by strengthening their capacities (planning, financing, management and information), they will ensure the provision of water and the protection of sources, in order to equitably satisfy the needs of an orderly and efficient demand; all within a framework of legislation that incorporates principles of sustainability. This concept basically aims to integrate three dimensions: a) within the individual sectors, integrate management of supply and demand and develop management capacities; b) between competitive uses, jointly plan the development of water resources with the participation of society and institutions; and c) the integration of State entities for both the legal-institutional design and the design of mechanisms for conflict resolution.

By adopting water security as the goal of water management and IWRM as the means to recreate the process, the need becomes evident for legislation that incorporates all of the public policies needed to ensure substantive, organizational and procedural measures to achieve specific goals and objectives that respond to social aspirations.

6.2. Global and regional policies

Global political leadership has been carried out by the United Nations General Assembly and the Conference of the Parties (COP)

regarding global agreements on climate change; whereas for the development of water resources, leadership has been carried out by

UNESCO as a specialized UN agency, and the UN-Water program.

Most noteworthy in the CARICOM

and SICA regions is the importance given to risk management and climate change, and, as part of their environmental strategies, to water management. These declarations and agreements constitute a source for promoting processes of change at a national level. Nevertheless, it is essential to define actions based on specific goals and results.

The member countries of CARICOM and SICA (geographically exposed to the impacts of climate change) are governed by the rule of law. Public policies made into laws reflect favorable aspects for water security issues, including IWRM and specific measures to deal with climate change, with differences that reflect their physiographic, demo-

graphic, economic and cultural particularities.

The legislative trends identified with regard to water were organized into five groups related to: a) the right to water, usually expressed in a water law; b) the provision of public water and sanitation services; c) environmental regulation for the conservation of the natural resource; d) legislation to manage risk and; e) legislation specifically related to climate change. These trends do not specifically address aspects such as access to information and conflict resolution, which are confined to the general legal regime.

In both regions, the common denominator of the legal systems is

the public nature of water and the guarantee to private property; this means that water rights granted to non-governmental individuals or collective persons to use waters or provide public services are protected by the Constitution.

The island states, with little or no water availability, focus on the regime of public water and sanitation services, around which measures of risk management and adaptation to climate change are established. Decentralization and the inclusion of the local government is a common trait. A single common model of water management in Central America has not been identified.

6.3. Local policies

The institutional framework, at the international, regional and especially national level, is organized on the basis of segmented functions related to IWRM, leading in many cases to a lack of definition of direct responsibility for local water security.

In spite of the presence of a variety of water-related institutions, no clear responsibility was found in any of the national cases regarding the granting of water rights - a central issue of water governance, nor an entity for regulation of water and sanitation - a necessary condition to ensure quality. It is possible that this uncertainty can be clarified in a water law, which neither country currently has.

Other parallel gaps relate to the scant political relevance given to the stewardship of water resources (hierarchical position, budgets and leadership); gaps in the application of regulations, linked to the lack of budget, personnel, training, equip-

ment, organization and systems for evaluation and monitoring; weaknesses in information systems; and weaknesses in the mechanisms for conflict resolution.

At the local level, municipal authorities have the political power to influence local decision-making and are entitled to act on behalf of the community. They show great interest in water management and climate change, but do not always treat them as a priority (compared to other issues with greater political visibility) and have limited resources to act. Thus, although the legal framework allows municipalities to have broad participation in finding solutions and moving forward in terms of issues related to water security, a process of empowerment is required, not only in terms of training and human resources, but also in terms of the budgets and support from high level authorities and/or international cooperation to plan and execute sustainable solutions.

We found, for example, that the coverage and quality of potable water and sanitation services in the municipalities, though statistically high, face challenges in terms of quality and sustainability, as reflected in the indicators for health, nutrition, education and development; other challenges include conflict resolution in relation to water-related economic activities, and risk management.

To advance in terms of water security, a change is needed in the approach to the planning of actions and budgets, which must start with the local reality and escalate to the national sphere in order to deal with challenges of a magnitude that requires the participation of more actors and more management capabilities.

7. Future developments

As mentioned before, it is at the local level where the consequences of the gaps left or permitted by the higher spheres are felt, in terms of failures of national policy frameworks or even failures in global paradigms. At the local level, however, solutions and approaches are identified from the existing opportunities for each reality, arising from the stakeholders themselves, and, at times, with external collaboration.

In this research study we found that it is especially important at the local level to develop capacities for solving specific problems and

resolving conflicts, and to have access to statistical and scientific information as well as plans and budgets to meet the challenges of water security and vulnerability to climate change.

We also noticed that in each geographic scale there are dynamics that favor the management of different aspects of water security. Therefore, it is necessary to understand these areas in the community, municipality, commonwealth, watershed, country, etc., in order to take advantage of the opportunities available.

Figure 13 shows a possibility of how aspects of water security can be addressed in different geographical areas, as well as a gradual development of capabilities. We believe that this is the way to design better solutions, provide greater sustainability to the measures, optimize investments, grant visibility and legitimacy to various groups and contribute to the empowerment of the population. However, it is necessary to deepen the interactions, considering them within the legal framework of water resources, and to harmonize plans from the bottom up.

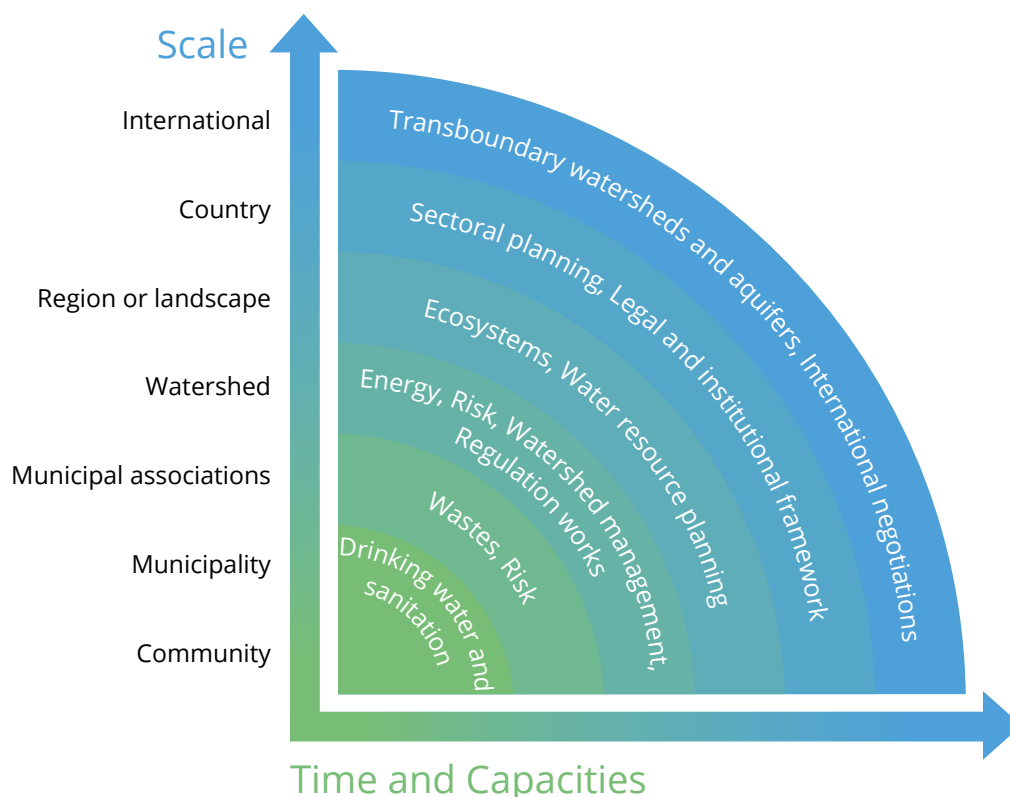


Figure 13. Different aspects of water security can be better managed in different geographical areas.

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- <http://apps.who.int/nutrition/landscape/report.aspx?iso=dom>
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Acronyms cited in national case studies

DOMINICAN REPUBLIC:

ASOCAR. Asociaciones Comunitarias de Acueductos Rurales [Community Rural Aqueduct Associations]

CAC. Consorcio Azucarero Central [Central Sugar Consortium]

CNCCMDL. Consejo Nacional de Cambio Climático y Mecanismo de Desarrollo Limpio [National Council for Climate Change and Clean Development Mechanisms]

CNE. Comisión Nacional de Emergencias [National Emergency Commission]

CNPMRD. Consejo Nacional de Prevención, Mitigación y Respuesta ante Desastres [National Council for Prevention, Mitigation and Response to Disasters]

CES. Comité de Emergencias y Salud [Health and Emergencies Committee]

COE. Centro de Operaciones de Emergencias [Emergency Operations Center]

COPE. Comité de Presas [Dam Committee]

CORAA. Corporaciones Regionales de Acueducto y Alcantarillado [Regional Aqueduct and Sewer Corporations]

CORAAVEGA. Corporación del Acueducto y Alcantarillado de la Vega [La Vega Aqueduct and Sewer Corporation]

CORAAROM. Corporación de Acueducto y Alcantarillado de La Romana [La Romana Aqueduct and Sewer Corporation]

CAASD. Corporación de Acueducto y Alcantarillado de Santo Domingo [Santo Domingo Aqueduct and Sewer Corporation]

CORAAPLLATA. Corporación de Acueductos y Alcantarillados de Puerto Plata [Puerto Plata Aqueduct and Sewer Corporation]

CORAAOCA. Corporación del Acueducto y Alcantarillado de Moca [Moca Aqueduct and Sewer Corporation]

CORAAASAN. Corporación del Acueducto y Alcantarillado de Santiago [Santiago Aqueduct and Sewer Corporation]

CTN. Comité Técnico Nacional de Prevención y Mitigación de Riesgos [National Technical Committee for Risk Prevention and Mitigation]

DGODT of the MEPyD. Dirección General de Ordenamiento Territorial [Department of Land-use Planning of the Ministry of Economy, Planning and Development]

EGEHID. Empresa de Generación Hidroeléctrica de la República Dominicana. [Hydroelectric Generation Company of the Dominican Republic]

EIGEO. Equipo Interinstitucional de Información Geoespacial [Interinstitutional Team for Geospatial Information]

FF. Financial Flows

FG: Focus Group

GASH. Grupo de Agua Saneamiento e Higiene [Water, Sanitation and Hygiene Group]

GIRH. Gestión Integrada de Recursos Hídricos

IDIAF. Instituto Dominicano de Investigaciones Agropecuarias y Forestales [Dominican Institute of Agriculture and Forestry Research]

IF. Investment Flows

INDRHI. Instituto Nacional de Recursos Hidráulicos [National Institute of Hydraulic Resources]

INTEC. Instituto Tecnológico de Santo Domingo [Santo Domingo Technological Institute]

INVI. Instituto de Vivienda [Institute of Housing]

IPCC. Intergovernmental Panel on Climate Change

ISA. Instituto Superior de Agricultura [Institute of Agriculture]

MEPyD. Ministerio de Economía, Planificación y Desarrollo [Ministry of Economy, Planning and Development]

MINERD. Ministerio de Educación [Ministry of Education]

MOPC. Ministerio de Obras Públicas y Comunicaciones [Ministry of Public Works and Communications]

NDP. National Development Plan

O&M. Operation and Monitoring

OISOE. Oficina de Ingenieros Supervisores de Obras del Estado [Office of Supervisory Engineers for Public Works]

ONAMET. Oficina Nacional de Meteorología [National Meteorology Office]

FGR. Procuraduría General de la República Dominicana [Office of the Attorney General of the Dominican Republic]

PRODEM. Programa de Desarrollo Municipal [Municipal Development Program]

PUCMM. Pontificia Universidad Católica Madre y Maestra [Mother and Teacher Pontifical Catholic University]

SGN. Servicio Geológico Nacional [National Geological Service]

SN-PMR. Sistema Nacional de Prevención, Mitigación y Respuesta ante Desastres [National System for Disaster Prevention, Mitigation and Response]

UASD. Universidad Autónoma de Santo Domingo [Autonomous University of Santo Domingo]

UCE. Universidad Central del Este [East Central University]

UCNE. Universidad Católica Nordestana [Nordestana Catholic University]

UGAMA Unidades de Gestión Ambiental Municipal [Municipal Environmental Management Units]

UNIBE. Universidad Iberoamericana [Ibero-American University]

UNPHU. Universidad Santo Domingo [University of Santo Domingo]

GUATEMALA:

AMASURLI Autoridad para el Manejo Sustentable de la Cuenca Hidrográfica del Lago de Izabal y Río Dulce [Authority for the Sustainable Management of the Lake Izabal and Dulce River Watershed]

AMPI Autoridad para el Manejo y Desarrollo Sostenible de la Cuenca del Lago Petén Itza [Authority for the Sustainable Management and Development of the Lake Peten Itza Watershed]

AMSA Autoridad de Manejo Sustentable de la Cuenca del Lago de Amatitlan [Authority for the Sustainable Management of the Lake Amatitlan Watershed]

AMSCLAE Autoridad para el Manejo Sustentable de la Cuenca del Lago de Atitlan [Authority for the Sustainable Management of the Lake Atitlan Watershed]

ARN Ministerio de Medio Ambiente y Recursos Naturales [Ministry of Environment and Natural Resources]

CARS Plan de Manejo de la Cuenca Alta del Río Samala [Management Plan for the Upper Watershed of the Samala River]

CATHALAC Centro del Agua del Trópico Húmedo para América Latina y el Caribe [Water Center for the Humid Tropics of Latin America and the Caribbean]

CEMA Central de Estudios del Mar y Acuicultura [Center for Ocean and Aquaculture Studies]

CNCC Consejo Nacional de Cambio Climático [National Climate Change Council]

CNE Centro Nacional de Epidemiología [National Center for Epidemiology]

COCODE Consejos Comunitarios de Desarrollo [Community Development Councils]

COLREDS Coordinadora Local para la Reducción de Desastres [Local Coordinator for Disaster Reduction]

COMRED Coordinadora Municipal para la Reducción de Desastres [Municipal Coordinator for Disaster Reduction]

COMSCARS Consejo para el Manejo Sostenible de la Cuenca Alta del Río Samala [Council for Sustainable Management of the Upper Watershed of the Samala River]

COMUDE Consejo Municipal de Desarrollo [Municipal Development Council]

CONADUR Consejo Nacional de Desarrollo Urbano y Rural [National Council for Urban and Rural Development]

CONAP Consejo Nacional de Áreas Protegidas [National Council for Protected Areas]

CONCYT Consejo Nacional de Ciencia y Tecnología [National Council for Science and Technology]

CONRED Coordinadora Nacional para la Reducción de Desastres de Origen Natural o Provocados [National Coordinator for the Reduction of Natural or Provoked Disasters]

CUNOCC Centro Universitario de Occidente de la Universidad de San Carlos [University Center West of the University of San Carlos]

CRD Comisión de Reducción de Desastres de la COMSCARS [COMSCARS Commission for Disaster Reduction]

DDA Dirección Municipal de Drenajes y Alcantarillas [Municipal Department of Drains and Sewers]

DDP Departmental Development Plans

DSA Dirección Municipal de Servicios Ambientales [Municipal Department of Environmental Services]

EMAX Empresa Municipal de Agua de Xelajú [Xelajú Municipal Water Company]

ERIS Escuela Regional de Ingeniería Sanitaria de la Universidad de San Carlos de Guatemala [Regional School of Sanitation Engineering of the University of San Carlos]

FG Focus Group

GHG Greenhouse Gas

IDB Inter-American Development Bank

IDRC International Development Research Centre

INAB Instituto Nacional de Bosques [National Institute of Forests]

INDE Instituto Nacional de Electrificación [National Institute of Electrification]

INFOM Instituto de Fomento Municipal [Institute of Municipal Development]

INGUAT Instituto Guatemalteco de Turismo [Guatemalan Tourism Institute]

INSIVUMEH Instituto Nacional de Sismología, Vulcanología, Meteorología e Hidrología [National Institute of Seismology, Vulcanology, Meteorology and Hydrology]

INTEC Instituto Tecnológico de Santo Domingo [Technological Institute of Santo Domingo]

IPCC Intergovernmental Panel on Climate Change IWRM Integrated Water Resources Management

MAGA Ministerio de Agricultura, Ganadería y Alimentación [Ministry of Agriculture, Cattle Farming and Food]

MARN Ministerio de Medio Ambiente y Recursos Naturales [Ministry of Environment and Natural Resources]

MDG Millenium Development Goal

MEM Ministerio de Energía y Minas [Ministry of Energy and Mines]

MICIVI Ministerio de Comunicaciones, Infraestructura y Vivienda [Ministry of Communications, Infrastructure and Housing]

MINEDUC Ministerio de Educación [Ministry of Education]

MINEX Ministerio de Relaciones Exteriores de Guatemala [Ministry of Foreign Relations of Guatemala]

MMMA Mancomunidad Metrópoli de los Altos [Highland Municipal Association]

MSPAS Ministerio de Salud Pública y Asistencia Social [Ministry of Public Health and Social Assistance]

NPS National Planning System

MDP Municipal Development Plans

PINFOR Programa de Incentivos Forestales [Forest Incentives Program]

PINPET Programa de Incentivos Forestales para Poseedores de Pequeñas Extensiones de Tierra de Vocación Forestal [Forest Incentives Program for Holders of Small Acreages Suitable for Forestry]

PREVDA. Programa Regional de Reducción de la Vulnerabilidad y Degradación Ambiental [Regional Plan for Reducing Vulnerability and Environmental Degradation]

PSMAA Plan Sectorial Multianual de Ambiente y Agua de 2010 [Multi-annual Sectoral Plan for Environment and Water 2010]

PSR Pressure-State-Response Framework

SEGEPLAN Secretaría de Planificación y Programación de la Presidencia [Secretary of the Presidency for Planning and Programming]

SWAT Soil and Water Assessment Tool

LUP Land Use Plan

UNFCCC United Nations Framework Convention on Climate Change

URHC Unidad de Recursos Hídricos y Cuencas del MARN [Water Resources and Watersheds Unit of the MARN]

USAC Universidad de San Carlos de Guatemala [University of San Carlos of Guatemala]

Annex 1: Rule of Law Country Analysis with regard to water resources

Below is an interpretation of the contents of the policies and laws that were identified based on the indicators presented in Table 2 and CATHALAC's reference framework (2015), including the following concepts: rule of law, human security, water security, integrated water resources management, climate change adaptation and decentralization; as well as the contributions to their realization.

CARICOM

Antigua and Barbuda

Antigua and Barbuda is governed by the rule of law under the Constitution of Antigua and Barbuda (1981), which includes the following fundamental rights: the right to life, to protection of property and to non-discrimination. It does not include the right to a healthy environment as a fundamental guarantee.

In regard to water, measures have been enacted (Public Utilities Act, 1973) related to all public services, by which the designated authority acts as both regulator and provider of public water services and sanitation for domestic and commercial purposes. Its decisions must be previously validated by a governing body, the minister and his cabinet.

The responsibilities of the authority include: management, maintenance, operation and supervision of all watercourses and water works to ensure adequate public supply; and the adoption of measures to protect the physical integrity of these.

The Hurricane, Earthquake, Fire or Flood Act of 1957 establishes provisions for emergencies, and, during such emergencies, empowers the government to intervene in water supply services.

Likewise, in 2002 (Disaster Management Act, 2002), a specific authority is created for prevention (alert) and response (emergency) to natural and social disasters, responsible at the national level and in the CARICOM region; empowered to present to the minister and his cabinet the respective plans for approval, assuming that it is the state's duty to adopt mitigation measures and ensure water supply in emergencies. It is part of a regional initiative.

In 2002, the government of Antigua and Barbuda prepared the document entitled Integrated Planning and Management for Adaptation, which includes guidelines for freshwater.

Bahamas

The Commonwealth of the Bahamas is governed by the rule of law under the Constitution of the Commonwealth of the Bahamas (1973), which includes the following fundamental rights: the right to life, to protection of property and to non-discrimination. It does not include the right to a healthy environment as a fundamental guarantee.

Through the Water and Sewerage Corporation Act of 2001, the water and sanitation company is organized and empowered as regulator and provider of the aforementioned services. Decisions regarding the provision of these public services must be approved by the regulatory authority of services and competition (Utilities Regulation and Competition Authority, URCA). This law also enables the company to have access to and to protect the water required to fulfill its functions.

The law creating the regulatory authority of services and competition (2010) defines this entity

as a regulator of public services, including water and sanitation.

In 2006, a specific authority for prevention (alert) and response (emergency) to natural and social disasters is created under the Disaster Preparedness and Response Act (2006), responsible at the national level and in the CARICOM region; it has the authority to present to the pertinent minister and government cabinets the respective plans for approval and coordination of government actions in the subject matter. It is part of a regional initiative.

The Bahamas government has prepared and approved the National Action Plan for Environmental Management of the Bahamas (2005) and the National Policy on Climate Change (2005). The latter is based on the principle of sustainable development and third generation rights, including considerations and measures on freshwater, for which a National Plan for Water Management is being prepared.

The National Action Plan for Environmental Management of the Bahamas (2005) does not consider water as a relevant element requiring integrated management; it only highlights the importance of domestic demand and the need to protect wetlands, which can be explained by the fact that in Bahamas there are no important rivers or lakes or major aquifers. The relevant water demands are domestic only, and groundwater is found at less than 5 feet beneath the surface and has traditionally been used for domestic purposes and even commercial uses and is treated by reverse osmosis.

Barbados

Barbados is governed by the rule of law under the Constitution of Barbados (1966), which includes the following fundamental rights: the right to life, to protection of property and to non-discrimination. The right to a healthy environment is not included as a fundamental guarantee.

The Barbados Water Authority Act of 1980 creates a water authority and charges it with: the collection, production, treatment, storage, supply and distribution of fresh water for all water uses; a natural resource information system; the management, allocation and monitoring of water to ensure its development; the use, conservation and protection of water in the public interest; and to make proposals for the development of water resources.

In 2002, also by decree (Utilities Regulation Act, 2002), a regulator of public services, including drinking water and sanitation, is instituted on the island.

In 2005, the Barbados government approves the National Strategic Plan of Barbados 2005-2025, whose fourth objective relates to strengthening national capacities for resilience to the impacts of climate change, including conservation measures, development of information systems, protection of surface and groundwater supplies including coastal aquifers; improved sanitation management; and the protection of marine coastal ecosystems.

In 2009, the Government presents a national adaptation strategy (National Adaptation Strategy and Action Plan) to address the impacts of climate change. Among the issues contemplated in this plan is the water stress the country will

be facing, leading to a call for the development of a plan to manage droughts and water availability.

Belize

Belize is governed by the rule of law under the Belize Constitution (1981), which includes the following fundamental rights: the right to life, to protection of property, to non-discrimination, to health and to a healthy environment.

In 2008, the national policy on IWRM (Integrated Water Resources Management National Policy (Including Climate Change) for Belize) is presented; and in 2010, a new decree is approved (National Integrated Water Resources Act), which becomes effective in 2011. For its application, a corporate authority is created under the Ministry of Natural Resources, which is assigned the task of proposing a master plan (National Water Resources Management Master Plan) and taking charge of the information system, as well as: implementing the provision contained in the law regarding the granting of rights, conditions for diverting water and the disposal of wastewater; establishing easements, regulating the use of groundwater, controlling contamination and protecting the areas surrounding water sources. It was not determined whether the aforementioned master plan was approved.

In 2009, thanks to a new piece of legislation (Environmental Protection Act, 2009), the protection of all elements of the biosphere is promoted, including water. The legislation also covers pollution control, empowering the Department of Environment to propose permissible limits on pollution for all kinds of effluents, subject to the approval of the

Minister of Forestry, Fisheries and Sustainable Development and his cabinet; as well as to regulate environmental impact studies.

Dominica

The Commonwealth of Dominica is governed by the rule of law under the Constitution of the Commonwealth of Dominica (1978), which includes the following fundamental rights: the right to life, to protection of property and to non-discrimination.

In 1972 a public commission was created and approved by legislative act (Public Utility Commission Act) to serve as a regulator of public services, including water and sanitation. Its responsibilities include: the provision of these services, the investigation of violations and the application of sanctions for failure to comply with regulations.

The Water and Sewerage Act of 1989 creates the Water and Sewerage Company, responsible for providing public water and sanitation services throughout the territory of the Commonwealth of Dominica. Its functions are subject to regulation by the public commission, and among its responsibilities is the development of water resources and their use, conservation and protection, observing the principle of third generation rights, for which it must promote a specific policy for application. The pertinent minister is empowered to create a Board of Water and Sanitation to provide orientation in these matters. This legal regime places under a single authority both the national company responsible for providing water service and sanitation and the water authority.

Dominica's national policy (National IWRM Policy, 2011), created in

a participatory manner, defines principles and implementation instruments, proposing the reform of both the water sector and the subsector of water and sanitation, as well as the formulation of a water resources master plan. Specific topics included in the policy are: climate change, flooding, water supply, water rights, management of watersheds and marine coastal zones, and addressing conflicts and measures for water security, which are considered part of national security.

Grenada

Grenada is governed by the rule of law under the Constitution of the Cooperative Republic of Grenada (1973), which includes the following fundamental rights: the right to life, to the protection of property and to non-discrimination, as well as the right to health, to a good quality of life, to a healthy environment and to participation in decision-making.

In 1999, the Public Utilities Commission Act creates an entity to regulate all public services in Grenada, including water and sanitation; the law regulates aspects such as functions, pricing, procedures, compliance with regulations, violations and penalties.

Subsequently, under the Water and Sewerage Act of 2002, the Ministry of Public Works is designated as the authority on water matters, with the right to delegate duties at its discretion. The National Water Council is established as an advising entity and empowered to propose policy tools in keeping with the principle of coordination. The authority is charged with responsibility for the information system and for all waters, both surface and groundwater, which are considered to be in the public domain, through a system of water

rights granted by licenses and predefined procedures. The law also includes specific rules with regard to drought situations and providers of water and sanitation services. It brings together in one legal instrument the regulations of the water authority and the provider of water and sanitation services, whose performance is supervised by the appointed commission.

Haiti

Haiti is governed by the rule of law under the Constitution of the Republic of Haiti (1987), which includes the following fundamental rights: the right to life, to the protection of property and to non-discrimination, as well as the right to health and to a healthy environment.

The law organizing the potable water sector (2009) creates the National Directorate of Potable Water and Sanitation (DINEPA, for its acronym in French), which is responsible for developing, regulating, and controlling the sector at the national level. DINEPA has a Potable Water Board and executive headquarters as well as regional offices. With the support of executive headquarters, the board formulates policies, proposes rates and establishes the conditions for state participation in infrastructure financing and the requirements that must be met by providers of these services, among other aspects.

No policy and planning instruments for water resources and climate change were identified on the websites.

Jamaica

Jamaica is governed by the rule of law under the Constitution of Jamaica (1962), which includes the following fundamental rights: the right to life, to the protection of property, and to non-discrimination.

The authority responsible for the nation's potable water and sanitation is created by the National Water Commission Act of 1963, based a national system to be designed. The authority is also tasked with the control and protection of natural resources, while maintaining and operating water services.

In previous legislation (Flood Water Control Act, 1958), flood prone areas were defined and preventive measures were proposed based on studies and research, through management schemes contemplated in a national plan announced by the Prime Minister and published in the official journal (gazette).

The commission created in 1963 aims to promote, assist and ensure the conservation of water resources in order to prevent and mitigate the impacts of flooding, by protecting specific watershed areas defined in accordance with a procedure established in the law. The owners of lands located within the protected areas must adhere to the limitations established by the authority, through special regulations approved by the minister, to ensure proper, efficient and economical use of watershed soils. For this purpose, the authority is empowered to control and inspect private lands under the provisions of this law.

In 1995, the water authority is created under the Water Resources Act and placed in charge of infor-

mation, planning, allocation of rights, control of water resource development and provision of technical assistance to other government offices. It is empowered to establish easements, to control and protect groundwater, and to ensure the quality and quantity of water through control and reserve plans.

In 2003, the Government designs an action plan to address climate change (Climate Change Policy Framework and Action Plan, 2013), through the Ministry of Water, Land, Environment and Climate Change, which contemplates foreseeable threats and impacts on the various natural resources, including water. The policy framework that is defined aims to create favorable conditions for an appropriate institutional environment that facilitates the development, coordination and implementation of the policies, sectoral plans, programs, strategies and legislation needed to address the impacts of climate change, for which a department of Climate Change and focal points are created.

This framework and action plan provides for specific programs for the management of water resources, including watershed protection measures to preserve and store water and/or moisture; it also recommends concrete actions such as the development of adaptation plans (at the parish, regional and national levels), the improvement of infrastructure for regulating water; and the development and implementation of storage technologies through a system of micro projects.

Saint Kitts and Nevis

The Federation of St. Kitts and Nevis is governed by the rule of law under the Constitution of

St. Kitts and Nevis (1983), which includes the following fundamental rights: the right to life, to the protection of property, and to non-discrimination.

The information is derived from the report submitted to the "Rio +20" Conference on Sustainable Development, held in Rio de Janeiro in 2012, which states that the country has a Department of Water Services responsible for providing water and sanitation as well as protecting water sources. It also indicates that the main legislation on water is contained in the 1956 ordinances on waterways and public works, which charge the water department with the provision of public water and sanitation, the prevention of waste, misuse and contamination of water, and the control of sanitation in the watersheds.

Saint Lucia

St. Lucia is governed by the rule of law under the Constitution of Saint Lucia (1978), which includes the following fundamental rights: the right to life, to the protection of property, and to non-discrimination.

The management of water resources on the island falls to the Water Resources Management Agency under the Ministry of Sustainable Development, Energy, Science and Technology. The agency is responsible for: granting water rights (licenses and permits); promoting sustainable use of the asset; assessment and planning; research and monitoring; and development of these resources. It is also responsible for managing watershed plans and master plans to assign rights of use, and recommend to the minister the areas that should be subject to special control. <http://nwsc.org.lc>

The provision of water and sanitation services is the responsibility of the National Water and Sanitation Commission, which is subject to the decisions made by the minister with regard to the regulation of services, in accordance with the established decree (Water and Sewerage Authority Act 1984). <http://nwsc.org.lc>

In 1992, the matter of land and conservation is regulated by decree (Land and Conservation Act, 1992), with specifications for the drainage of agricultural lands as well as the prevention and mitigation of the effects of flooding, erosion, and extreme water-related events.

Saint Vincent and Grenadines

Saint Vincent and Grenadines is governed by the rule of law under the Constitution of St. Vincent and Grenadines (1979), which includes the following fundamental rights: the right to life, to the protection of property, and to non-discrimination.

An examination of the state's National Report presented at the Third Conference of Small Islands (2013) reveals the presence of a central authority in charge of public water and sanitation services, called the Central Water and Sewerage Authority, an entity that continuously monitors water availability and recommends measures for the predictable occurrence of drought phenomena.

The National Economic and Social Development Plan (2013-2025) submitted by the Government of Saint Vincent and Grenadines proposes, as its fourth strategic objective, to improve physical infrastructure, preserve the environment and improve resilience; included among the sectoral strate-

gies related to the environment are water and risk management.

http://finance.gov.vc/images/stories/Central_Planning/svg%20nesdp%20pages%201-52.pdf;
http://finance.gov.vc/images/stories/Central_Planning/svg%20nesdp%20pages%2053-148.pdf

There is also a roadmap for IWRM planning, formulated as part of a GWP-IWAM project on watersheds and coastal areas, which assesses the water situation and indicates that no special legal regime exists. <http://www.gwp.org/Global/ToolBox/About/IWRM/America/Union%20Island,%20St.%20Vincent%20and%20the%20Grenadines%20IWRM%20Roadmap.pdf>

The FAOLEX database was consulted but no legislation related to the subject matter of this study was identified.

Suriname

Suriname is governed by the rule of law under the Constitution of Suriname (1987), which includes the following fundamental rights: the right to life, to the protection of property, and to non-discrimination.

The Water Act of 1938 establishes regulation of the provision of water and sanitation services for domestic purposes. Management of water as a resource is not supported by laws or institutions, generating greater uncertainty as stated by Del Prado (2013) in the Legal Framework Analysis report developed for the Amazon Cooperation Treaty Organization (ACTO), and is limited to the provision of the aforementioned services mainly in the coastal area of the country.

The FAOLEX database was consulted but no legislation related to the subject matter of this study was identified.

Trinidad and Tobago

Trinidad and Tobago is governed by the rule of law under the Constitution of the Republic of Trinidad and Tobago (1976), which includes the following fundamental rights: the right to life, to the protection of property, and to non-discrimination.

This state has a water and sanitation authority (1976) to which the Water Resources Agency is attached; the first is responsible for providing the aforementioned services under the regulations approved by the minister and his cabinet; the second is responsible for the resource, its measurement, planning and allocation through licensing.

The water and sanitation authority acts in accordance with the Water and Sewerage Act of 1969; it also establishes provisions related to water as a resource, to the need to preserve and protect water, and to the granting of water rights for various uses, under the responsibility of the Water Resources Agency. Pollution control, on the other hand, corresponds to the environmental authority under the Environmental Management Act of 2000.

Costa Rica

Costa Rica is governed by the rule of law under the Constitution of the Republic of Costa Rica (1949), which guarantees the fundamental rights to life, equality, property, health, and a healthy and ecologically balanced environment (Reform of 1994).

The Water Law (1942) focuses on securing the asset as a public good and defining the mechanisms and procedures for granting rights of use; it places special emphasis on domestic and energy use, as well as on the protection of forests, especially along rivers; it observes principles of efficiency and sustainability, establishes priorities for use and regulates the rights and obligations of users.

The Law of the Regulatory Authority of Public Services (1996) governs the provision of water and sanitation services, and the Institute of Aqueducts and Sewers (1961) is responsible for the supervision and provision of urban services, together with numerous rural organizations in charge of management in rural areas.

Costa Rica defines and approves the Strategy for Integrated Water Resources Management (2004) based on the IWRM paradigm, adopting the principles of equity, efficiency, sustainability and citizen participation.

El Salvador

El Salvador is governed by the rule of law under the Constitution of El Salvador (1983), which guarantees fundamental rights to life, equality, property, health and a healthy environment, asserting that the state guarantees the protection, conservation and restoration of natural resources, as well as their rational use.

The Law of the Executive Hydroelectric Commission of Rio Lempa CEL (1948) lays the foundations for the development of water resources, although not exclusively, but to satisfy the diverse demands for water around the most important source of surface water in terms of availability. The Executive Committee aims to conserve, manage and utilize water, and is responsible for research, information and planning.

The management of public water and sanitation services has been regulated since 1961 under the Law of the National Administration of Aqueducts and Sewers (ANDA, for its acronym in Spanish), which is the regulator and provider within the structure of the water and sanitation subsector. The law includes a special regime of water easements and the obligation to comply with health standards in the performance of its duties.

Irrigation is regulated by the Irrigation and Drainage Act (1970), aimed at promoting the rational use of land and water to increase production; likewise, it constitutes water easements and regulates the conservation the natural resource, which is considered to be in the public domain. The law

includes provisions to terminate the possibility of granting water rights, to regulate standards for granting permits and exploitation concessions, and special measures for regulation of groundwater, infringements and penalties. It organizes irrigation and drainage districts, as well as irrigation organizations.

In 1981 the Assembly enacted the Law on Integrated Water Resources Management, which considers water to be a constituent element of the hydrological cycle, as well as an essential and indispensable public resource subject to national planning and administration. The implementing authority is the ministry responsible for planning and coordinating development; the focus of the uses is defined as integral and multiple. The creation of a decentralized National Plan for Development and Use of Water Resources, which contemplates the watershed as a management unit, has been ordered.

Guatemala

Guatemala is governed by the rule of law under the Constitution of the Republic of Guatemala (1985), which guarantees the fundamental rights to life, equality, property, health and a healthy environment, declaring that the state guarantees the protection and conservation of natural resources and their rational use, determining the creation of a special law related to water.

The portion of the Civil Code (1932) currently in force defines the standards for priority of access; establishes how the rights to use public waters are to be granted; and grants them according to the natural capacity of the sources.

The Constitution assigns to the municipality the responsibility for providing water services and sanitation, regulated by both the Municipal Code and the Code of Health. The municipality acts in the capacity of provider and regulator, while the Ministry of Health acts in a supervisory capacity and thousands of civil associations manage the systems to supply water to the population in rural areas.

Public policy regarding the management of the conservation of natural resources has been to organize watershed authorities which, without a common legal standard, are created around a particular water source. They are assigned to manage all natural, social and cultural assets, including water, but they are not empowered to develop water resources. Watershed authorities have been created for the Amatitlan and Atitlan Lakes, among others.

Risk management has formed part of public policy measures adopted throughout the twentieth century and up until very recently, following the impact caused by an extraordinary hydroclimatological event. Now, it is part of a national management system based on prevention, regulated by the Law of the General Coordinator for the Reduction of Natural or Provoked Disasters (1996), the implementation of which is decentralized.

The President of the Republic approved the Guatemalan Water Agenda (2013), which includes forecasts for the planning of water regulation (to store and/or dissipate energy) and is not covered by general law, and the State Policy on International Watercourses (2012) to address bilateral and multilateral relations related to international watercourses.

Honduras

Honduras is governed by the rule of law under the Constitution of Honduras (1982), which guarantees fundamental rights to life, equality, property, health and a healthy environment; it declares that the state is the guarantor of environmental conservation, and establishes an Attorney for the Environment.

In 2003, the National Congress issued the Framework Law for the Water and Sanitation Sector, creating an agency to regulate the provision of these services. It establishes the rights and obligations of users and providers, the conditions for provision of service, a regime for establishing rates and a system of infringements and penalties, as well as a special regime of easements.

In 2009, the National Congress renewed its old water law (1927) and issued the General Water Law, based on the paradigm of integrated management, which establishes human consumption as a top usage priority, and calls for citizen participation in all aspects, from planning to management, use and conservation. It refers to surface and ground water and to all uses of water. A new management system is created, attached to the secretariat responsible for natural resources and the environment, and represented by a council, an institute, watershed organizations, user organizations and advisory councils, with powers assigned to each.

The Government of Honduras defines a National Climate Change Strategy that includes the water sector, identifying threats and factors that increase vulnerability and potential impacts, and defining strategic adaptation objectives.

Nicaragua

Nicaragua is governed by the rule of law under the Constitution of Nicaragua (2003), which guarantees fundamental rights to life, equality, property, health and a healthy environment; it also declares that the state is the guarantor of environmental conservation.

The Assembly enacts the General Law on Drinking Water and Sewer Services (1998), and assigns a regulatory agency, the Nicaraguan Institute of Aqueducts and Sewers (INAA, for its acronym in Spanish); the law defines the regime of concessions for service providers, as well as the rights and duties of the state, users and concession holders; and a regime of infringements and penalties. That same year, the Assembly issues the law creating the Nicaraguan Water and Sewer Company (ENACAL, for its acronym in Spanish), whose main function is to provide water and sanitation services. At the same time, the Executive issues a decree creating the National Commission of Water and Sewerage to fulfill supervisory functions.

To regulate the performance of the numerous social organizations that provide water and sanitation services in rural areas, the Legislative Assembly issues a Special Law on Water and Sanitation Committees (2010), defining the powers, functions and duties of these organizations, as well as how they are integrated into the national service administration system.

As for public policies, the Assembly adopted Resolution 0003-2009, based on the environmental law that contemplates regional declarations and plans, encouraging the executive to "formulate and promote a Climate Change Adaptation Policy." In 2010, the

central government presents the National Environmental and Climate Change Strategy Action Plan 2010-2015, which includes the conservation, recovery and harvest of water sources in watersheds to ensure the functions of water recharge, as well as specific actions to implement the National Water Harvesting Program and the program to reduce pollution in Lake Cocibolca.

Panama

Panama is governed by the rule of law under the Constitution of the Republic of Panama (1972), which guarantees fundamental rights to life, equality, property, health and a healthy environment, stipulating that is the state's duty to ensure a healthy and unpolluted environment for the population. The underground and thermal waters form part of the state's patrimony, while the freshwater used for irrigation, energy, drains and aqueducts is considered to be in the public domain and for special purposes.

The special law on this subject is called the Decree Law on Water Use, issued in 1966, which regulates the exploitation of the nation's water in the interest of society, for public welfare and for the conservation of water, with regard to all uses. It establishes the system for granting water rights, permits and concessions and for instituting water easements, and includes a special system of infringements and penalties. Its application corresponds to the National Environmental Authority, elevated to the status of Ministry in 2014.

In 1996, the Legislature issues the law creating the Regulator of Public Services, which includes potable water and sewer services. The law

establishes the duties and rights of the state, providers and users, particularly the regime of rates. It is also empowered to grant concessions for the provision of these services.

In 2001, the Legislative Assembly modernizes the legal regime of the Institute of National Aqueducts and Sewers (IDAAN, for its acronym in Spanish), as an entity which not only supervises and provides services, but is also responsible for coordinating water use and contributing to the conservation of watersheds and to the protection of the environment, among others.

In 2002, the Assembly establishes a special regime for the management, protection and conservation of watersheds, common to all, introducing and coordinating planning tools for both land use and water management. Its most important feature is its decentralized focus and integration into the Watershed Committee management system. This regime does not apply to the Panama Canal watershed.

Undoubtedly, the legal regime of greatest importance to the nation and to water governance in Panama is that of the Panama Canal; this implies the decentralized and regional management of the waters of the respective watershed.

Dominican Republic

Law 12 (2012) approves the National Development Strategy 2030, whose fourth strategic objective establishes general and specific objectives and lines of action on environmental matters.

General objective 4.1, "Sustainable management of the environment", includes specific objective 4.1.4 referring to water security; objective 4.2, "Effective risk management to minimize human, economic and environmental losses", also implies good water management; and objective 4.3, "Adequate adaptation to climate change", defines lines of action to reduce vulnerability, mitigate and adapt; it also requires the best management and governance of water.

The lines of action of specific objective 4.1.4 establish criteria for: sustainable and efficient management and integrated and coordinated planning; reformulation of water policy philosophy to emphasize efficiency in water use rather than supply; and the need to regulate water (works). The importance of co-responsible citizen participation is highlighted, as well as the need for sustainable conservation and management to mitigate the effects of climate change.

Annex 2. Adaptation measures provided by the municipalities

Guatemala, Santa Cruz Mulua

No.	ACTIVITY / PROJECT	TERM			CLASS	TYPE OF MEASURE
		S	M	L		
1	WATER SOURCES					
1.1	Alliance MSPAS, MARN, Municipality for monitoring water quality, sources and reforestation	●			C	Coordination
1.2	Inventory and characterization of water sources	●			S	Research
1.3	Create private fund which facilitates adequate management of water sources	●			C	Financing
1.4	Communicate and enforce regulations that prevent deforestation.	●			D	Regulation
1.5	Increase personnel for monitoring of compliance with environmental regulations		●		D	Monitoring
1.6	Develop and implement a solid waste management program		●		D	Waste
2	SERVICES					
2.1	Review and update models for provision of municipal services	●			C	Institutional
2.2	Follow-up on well processes begun by municipality for potable water	●			S	Intake
2.3	Training in issues: legal framework for water security, solid waste policies	●			C	Training
2.4	Strengthen process for improving water quality for all uses		●		S	Treatment
2.5	Incorporate new technologies for improving provision of municipal services		●		C	Capacities
2.6	Prepare technical study on Waste Water, for compliance with regulation 236-2006		●		C	Research
2.7	Improve fee collection system for municipal public services		●		C	Financing
2.8	Create a procedures manual for administration of water services		●		C	Administration
2.9	Strengthen water-related administrative resources (personnel, equipment, information systems)		●		C	Human resources
3	GOVERNANCE					
3.1	Strengthen Municipal Affairs Court to handle water security	●			C	Training-Coordination
3.2	Strengthening and training of COCODES and COMUDE (legal aspects and NPS)	●			C	Training
3.3	Prepare plan for approaching and communicating with communities	●			P	Participation
3.4	Create private fund for improving governance related to water security	●			C	Financing

Classification S: Supply; D: Demand; C: Strengthening of Capacities; P: Participation
Term S: Short; M: Medium; L: Long

No.	ACTIVITY / PROJECT	TERM			CLASS	TYPE OF MEASURE
		S	M	L		
3.5	Conduct study of possible alternative water sources and needs of the population		●		C	Research
4	WATER AND DEVELOPMENT					
4.1	Identify, classify and regulate the different water uses in the municipality	●			D	Regulation
4.2	Implement differentiation of rates for different water uses	●			C	Financing
4.3	Issue regulations governing the different water uses	●			D	Regulation
4.4	Work program for environmental adjustments to polluting businesses		●		D	Regulation
4.5	Create a Land-Use Plan		●		D	Land-Use Planning
4.6	<i>Develop an environmental education program. Agreement MARN, MINEDUC, Health, to create awareness among authorities on the care and use of water</i>		●		D	Education
5	RISKS					
5.1	Creation, accreditation and training of COMRED and COLRED in light of SE-CONRED	●			C	Training
5.2	Create alliance with INAB, MARN, CONRED and sugar mills for reforestation, dredging and banks	●			C	Coordination
5.3	Coordinate with entities of upper watershed, lower watershed, INSIVUMEH For SAT	●			C	Coordination
5.4	Create Municipal Land-Use Plan (medium term)		●		D	Land-Use Planning

Guatemala, Quetzaltenango

ACTIVITY / PROJECT	LEADERSHIP	TERM			Water Security Issue	CLASSIFICATION
		S	M	L		
MUNICIPAL SCALE						
Create municipal agreement for regulation of municipal water uses	EMAX	●			Water and development	Municipal regulations
Increase water supply to expand service coverage	EMAX	●			Services	Intake infrastructure
Set rates according to socioeconomic level of families	EMAX	●			Services	Economic instrument
Municipal regulation of private water service suppliers	EMAX	●			Services	Municipal regulations
Economic analysis of viable institutional model for strengthening EMAX without affecting municipal sustainability	EMAX	●			Services	Municipal entity
Review salaries and job stability in EMAX	EMAX	●			Services	Human resources
Awareness campaigns on the true cost of providing water. Massive campaign on adequate water use.	EMAX	●			Services	Education

ACTIVITY / PROJECT	LEADERSHIP	TERM			Water Security Issue	CLASSIFICATION
		S	M	L		
Public-private alliance to promote the use of cutting-edge technology. Promote the use of water saving technologies and water reuse in production and industrial processes.	EMAX	●			Water and development	Education, economic and regulatory instruments
Promote participation of the different chambers (industry, commerce, others)	EMAX, Municipality	●			Water and development	Promote participation
Database of manuals, regulations and initiatives related to water management	DSA, EMAX	●			Water and development	Regulation
Implement system of sanctions for improper water use and incentives for proper use	Municipalidad	●			Water and development	Regulation, supervision and economic instruments
Define roles of population-municipality regarding water governance. Create a supervising entity (entities and population) to care for water resources.	Municipalidad	●			Governance	Promote participation
Strategic analysis for strengthening Department of Drains and Sewers	DDA	●			Services	Municipal entity
Communicate existing regulations to the population in a clear manner	DSA	●			Governance	Education
Develop comprehensive health programs for different sectors of the population	DSA and Health Committee	●			Health	Education
Strengthen and improve health care services at the municipal level	Health Committee	●			Health	Human resources
Strengthen the health commission to assume a leading role and be an articulator	Health Committee	●			Health	Human resources and financing
Strengthen municipal mandates for controlling, regulating and improving water quality	Health Committee	●			Health	Regulation and supervision
Train community members regarding the Law on Urban and Rural Development Councils	SEGEPLAN	●			Governance	Promote participation
Follow-up on compliance by COCODES in accordance with the law	SEGEPLAN	●			Governance	Promote participation
Create municipal water governance entity in EMAX (water court)	EMAX		●		Services	Municipal entity
Change pipes of entire system for galvanized iron.	EMAX		●		Services	Distribution infrastructure
Systematize and standardize the requirements and procedures of municipal public services	EMAX, Municipality		●		Services	Administration and procedures
Establish single registry office for municipal services	EMAX, Municipality		●		Services	Administration and procedures
Improve information systems, with Geographic Information Systems and record of statistics.	EMAX, Municipality		●		Governance	Information systems
Generate geographic, sociodemographic and health information for vulnerable áreas	Health Committee		●		Governance	Information systems
Generate municipal policies for comprehensive health care	Health Committee		●		Health	Municipal regulations
Establish Ministry of Communications MICIVI-Municipality agreement for better administration and maintenance of national roads in the municipality	MICIVI-Municipality		●		Water and development	Coordination
Coordinate with INFOM (Institute of Municipal Development)	Municipalidad, INFOM		●		Governance	Coordination
MUNICIPAL ASSOCIATION SCALE						

ACTIVITY / PROJECT	LEADERSHIP	TERM			Water Security Issue	CLASSIFICATION
		S	M	L		
Coordination between MARN-Municipality for construction of waste water treatment plant	DDA	●			Services	Treatment Infrastructure
Strengthening of Highlands Municipal Association – Forum on sustainability “Council of the Upper Watershed of the Samala River”	MMMA	●			Governance	Promote participation
Program in annual phases (diagnosis, studies, implementation) compliance with Regulation 236-2009 on wastewater treatment	DDA		●		Services	Treatment Infrastructure
Create a common body of regulations for water management in all of the municipalities	MMMA		●		Water and development	Participation/ Manage-ment of water demand
WATERSHED SCALE						
Train human resource in Watershed Modeling and IWRM	Municipality	●			Sources	Human resources
Massive reforestation campaign	DSA, EMAX, private initiative, COMUDE, COCODEs	●			Sources	Watershed management
Facilitate PINFOR and PINPET projects at the municipal level	DSA, COMUDE, COCODEs	●			Sources	Watershed management
Construction of infiltration wells	DSA	●			Sources	Watershed management
Construction of urban rainwater-harvesting demo	DSA	●			Sources	Watershed management
Delegate sustainable management of natural resources to communities located in water recharge zones	DSA, MMMA	●			Sources	Promote participation
Construct risk mitigation projects	DDA	●			Risks	Infrastructure, risks
Reinforce activities for cleaning gutters and gullies. Evaluate creation of new Heads of Drains and Sewers or Environmental Services	DDA	●			Risks	Risks
Strengthen social monitoring for participation in risk-related decision	COMUDE and COCODEs	●			Risks	Risks
Within institutions, enforce laws on protection and risks	COMRED	●			Risks	Risks
Delimitation of protected areas, increase private protected areas	DSA		●		Sources	Watershed management
Implement Land-Use Plan. Institutions enforce land-use regulations in order to prevent risk			●		Water and development	Regulation, Risks
REGIONAL OR NATIONAL SCALE						
Promote cultural zoning of water use, customary laws	MMMA	●			Governance	Regulation
Revalidate and update Guatemala´s National Water Policy.	MOA, COMSCARS, MMMA	●			Governance	National legislation
Create draft bill on water use (domestic, agricultural and industrial uses)	MOA, COMSCARS, MMMA		●		Governance	National legislation

Term S: Short; M: Medium; L: Long

Dominican Republic, Guayabal

PROJECTS AS ADAPTATION MEASURES (Relationship to NDP: Specific Obj.)	Term			Prioritization	Class	Type of measure
	S	M	L			
SERVICES (2.5.2; 4.1)						
Train INAPA personnel and other facilitators in the management and control of chemicals that are added to water	●			1	C	Human resources
Construct a potabilization plant for the aqueduct	●			2	S	Potabilization infrastructure
Construction of aqueducts		●			S	Distribution infrastructure (AP)
Construction of sewer and waste water treatment plant in Guayabal		●			S	Treatment infrastructure
WATER AND DEVELOPMENT (3.5.3; 4.1)						
Installation of irrigation systems		●			S	Distribution infrastructure (irrigation)
Construction of dams for irrigation and domestic use			●		S	Storage infrastructure
WATER SOURCES (4.1)						
Technical assistance to implement reforestation project at watershed level	●			3	D	Education
Reforestation of stream banks or watersheds with native species	●			1	S	Watershed management
Educational project for the population with regard to the care and management of watersheds	●			2	D	Education
Public awareness campaigns on the use and care of water	●			4	D	Education
Raise awareness among farmers about contamination of water sources	●			3	D	Education
Sanction bad practices in forests	●			3	D	Supervision
Brigades paid for by the State or another institution to care for and preserve the watersheds and fight fires.	●				C	Human resources
Soil conservation practices with living or non-living barriers	●				S	Watershed management
Draft plans for land use		●			D	Land-Use Planning
Create a municipal water reserve		●			S	Watershed management
Reforest other areas and stream Banks, such as Ventura, Enemencio, La Guama, La Vaca, La Viejana, La Caña, Prieto, Colorado, La Columna, Maselino, Río Cueva, etc.			●		S	Watershed management

Classification S: Supply; D: Demand; C: Strengthening of Capacities; P: Participation
 Term S: Short; M: Medium; L: Long

Dominican Republic, Tamayo

RESPONSE (Relationship to NDP: Specific Objective)	Term			Priority	Class	Tipo de medida
	C	M	L			
WATER SOURCES (4.1)						
Reforestation of watersheds	●			1	S	Watersheds
Set up roundtables and inter-institutional planning for water resources	●			2	C	Coordination
Projects for water recharge	●			3	S	Watersheds
Planning of water use and supply	●			4	D	Regulation
Awareness campaigns on protection and care (reforestation) MARN		●			D	Education
Establish program of payment for environmental services			●		D	Economic
Soil conservation projects			●		S	Watersheds
SERVICES (2.5.2; 4.1)						
Distribution: Modernize current water distribution projects to economize	●			1	S	Distribution infrastructure
Apply sealant to latrine systems and irrigation ditches	●			1	S	Sanitation infrastructure
Maintenance: Clean irrigation ditches belonging to users	●			2	S	Maintenance of infrastructure
Intake: Construct artificial ponds	●			3	S	Intake infrastructure
Institutional strengthening: Institutions such as INAPA and NGOs must implement new practices for transfer of new technologies	●			4	C	Human resources and training
Projects for channeling river water	●			5	S	Distribution infrastructure
Improve waste water service in homes and sanitation measures		●		6	S	Sanitation infrastructure
Construction of tanks		●		7	S	Intake infrastructure
Use biodegradable products to replace the use of lime and lye			●	8	D	Regulation, education
WATER USE AND DEVELOPMENT (3.5.3; 4.1)						
Create plan for management of water use	●			1	C	Planning
Replace infrastructure of water system to prevent leaks	●				S	Distribution infrastructure
Empower authorities to regulate water use in agriculture	●				C	Coordination
Promote organic agriculture to decrease outbreaks caused by chemicals.		●			D	Regulation, education, Economic Instruments
Generate an information system for water demand			●		C	Information systems
Recondition water intakes and irrigation systems			●		S	Distribution infrastructure
RISKS (4.2, 4.3)						
Construction of drains for urban areas and agricultural lands	●			1	S	Regulation and distribution infrastructure
Acquire tools, machinery and equipment for handling disasters and emergencies	●			2	C	Human resources
Design an early alert system for both droughts and flooding	●			3	C	Coordination, information
Awareness and information campaign on risk management through local media	●			4	C	Coordination
Construction of water intake infrastructure and reservoirs		●		5	S	Regulation infrastructure
Awareness talks in schools and communities		●		6	C	Education
Establish a timeline for work and follow-up to strengthening emergency organizations to handle natural disasters		●		7	C	Coordinación y planificación
Program of reforestation of river banks with endemic, native and naturalized plants		●		8	O	Cuencas

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