

POLICY BRIEF  
FOR DECISION MAKERS



**WATER SECURITY  
AND CLIMATE CHANGE**  
IN CENTRAL AMERICA AND THE CARIBBEAN



**CATHALAC**

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



The Water Center for the Humid Tropics of Latin America and the Caribbean (CATHALAC in Spanish) is an international organization based in Panama City, established in 1992 to promote sustainable development in Latin America and the Caribbean through applied research, education and technology transfer. CATHALAC develops its management in four areas:

- ▶ Integrated watershed management;
- ▶ Climate change;
- ▶ Environmental modeling and analysis; and
- ▶ Risk management.



The International Development Research Centre (IDRC) is a public corporation created by the Parliament of Canada in 1970 to help developing countries use science and technology to find practical solutions to the long-term social, economic and environmental problems they face.

Since its inception, IDRC has worked in close cooperation with researchers from Latin America and the Caribbean. IDRC activities in Latin America and the Caribbean are coordinated by the Regional Office based in Montevideo, Uruguay.

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# Water security and climate change in the region of Central America and the Caribbean.

Case studies for Guatemala and the Dominican Republic and four pilot municipalities.

## WATER SECURITY

UN-Water (2013) defines water security as "the capacity of a population to safeguard sustainable access to adequate quantities of acceptable quality water for sustaining livelihoods, human well-being<sup>1</sup>, 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".

The concept of water security has the virtue of attracting political interest to raise the importance of water in the state agendas; it also offers the opportunity to harmonize sectorial policies towards an integrated vision that breaks the historical trend of managing water in separate sectors such as environment, health, agriculture and energy.

There is growing global concern about water security as pressure from human activities increases and the availability of water resources decreases both in quantity and quality worldwide. Climate change could exacerbate the global water crisis to the point of reaching critical levels, especially in the most vulnerable areas, such as the region of Central America and the Caribbean.

<sup>1</sup> Human well-being has multiple aspects, including the basics for a good life, election and action freedom, health, good social relations, and security (MA, 2003 in UN-Water, 2013).







# CENTRAL AMERICA AND THE CARIBBEAN

The region of Central America and the Caribbean is politically divided into 22 states that cooperate in various regional integration organizations such as the Central American Integration System (SICA, in Spanish), the Caribbean Community (CARICOM) and the Association of Caribbean States (ACS).

General environmental issues, and water management in particular, have represented key issues in regional integration agendas, especially in the context of current discussions on vulnerability and adaptation to climate change. Indeed, the region has suffered the devastating effects of climate variability and extreme events such as floods, droughts, tornados, frost, among others. Some historical

natural events that have affected the region include:

- ▶ Tropical Storm Agatha (May 2010);
- ▶ Flooding resulting from Hurricane Stan in El Salvador and Guatemala (October 2005);
- ▶ Hurricane Mitch (October 1998).

# Integrated Water Resources Management (IWRM)

The IWRM concept was already being proposed in the World Water Forum held in: Marrakech, Morocco (1997); The Hague, Kingdom of the Netherlands (2000); and Kyoto, Japan (2003); and its validity was confirmed in the forums that followed until Daegu, Korea in 2015.

Water security reflects the degree of success that a given population has in water management, but it is necessary to build appropriate goals in a participatory manner and at the lowest possible level in order to avoid, as Quiroga (2003) and Chocie (2012) warn, the widespread use of global indices that hide inequities or devalue individual experiences.

To achieve water security, CATHALAC proposes an innovative Integrated Water Resources Management (IWRM) approach. Grounded in the IWRM methodology, this proposal is based on the following six pillars: Pillar A - Legal Framework; Pillar B - Institutions; Pillar C - Participation; Pillar D - Management Capabilities; Pillar E - Supply Management; and Pillar F - Demand Management. (Figure 1).

In this regard, a joint management between various institutions and society is proposed, which, by strengthening capacities for planning, financing, administration and information, will ensure water supply and the protection of water sources to equitably meet the needs of an orderly and efficient demand within a legislation framework that contemplates principles of sustainability. This model basically seeks to integrate two dimensions: on the one hand, the sectors through their institutions and users (e.g. agriculture, energy and transportation); and on the other, the consideration

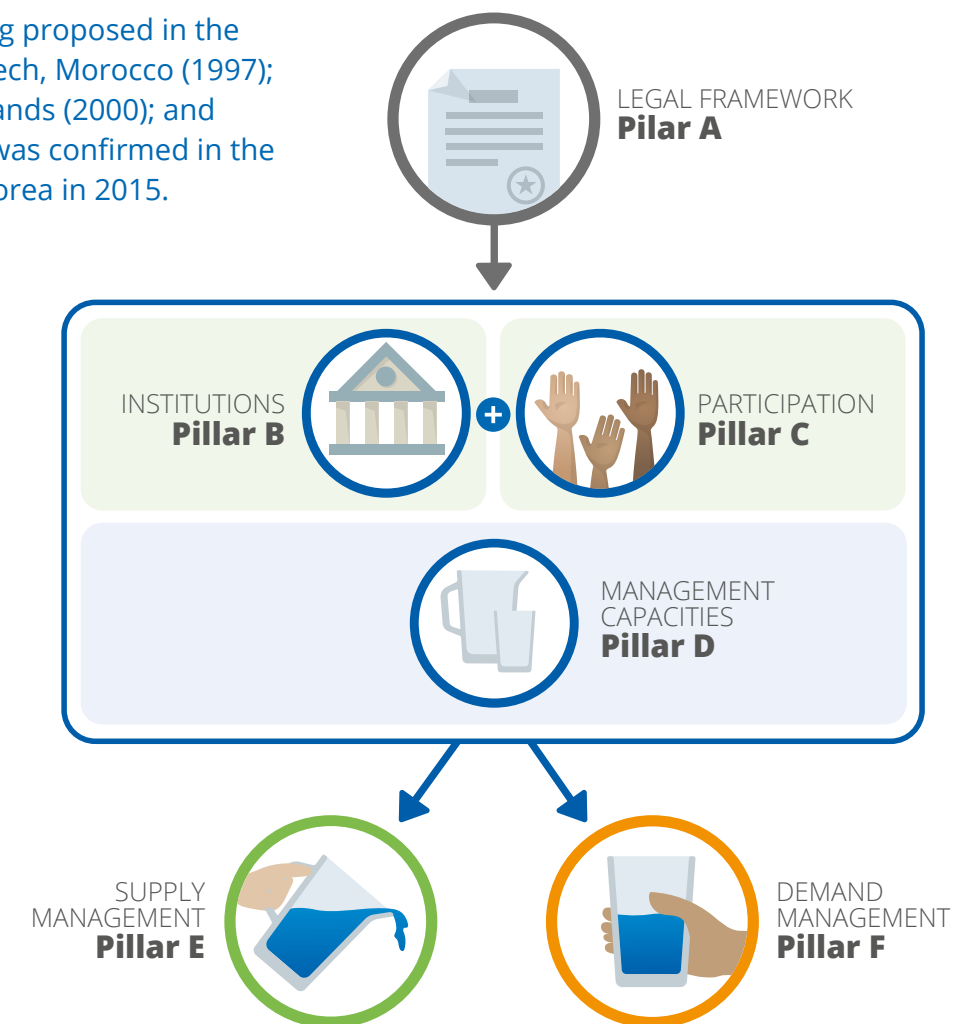


Figure 1. Water management framework for water security facing climate change (CATHALAC, 2015)

of not only the provision of water and protection of sources (supply), but the management of demand as well.

In many countries, demand management is one of the most neglected aspects of water management, which is critical, because no amount of water can satisfy a disorderly and inefficient demand. Among the objectives of demand management are:

- ▶ control and manage the increase in the use of water,
- ▶ increase efficiency,
- ▶ reduce contamination, and
- ▶ avoid conflicts.

The reality is that the sectors that use water generally limit their actions to transporting the liquid through infrastructure without addressing the sources or paying attention to the way the resource is

being used. By managing demand, the provider directs the behavior of different users, relying on instruments such as education, regulation and control, economic instruments, coordination, participation and conflict resolution (2). This is not exclusive to each sector; the idea is to construct rules and processes for sustainable water use that are harmonized in a joint and integrated vision focused on water security.

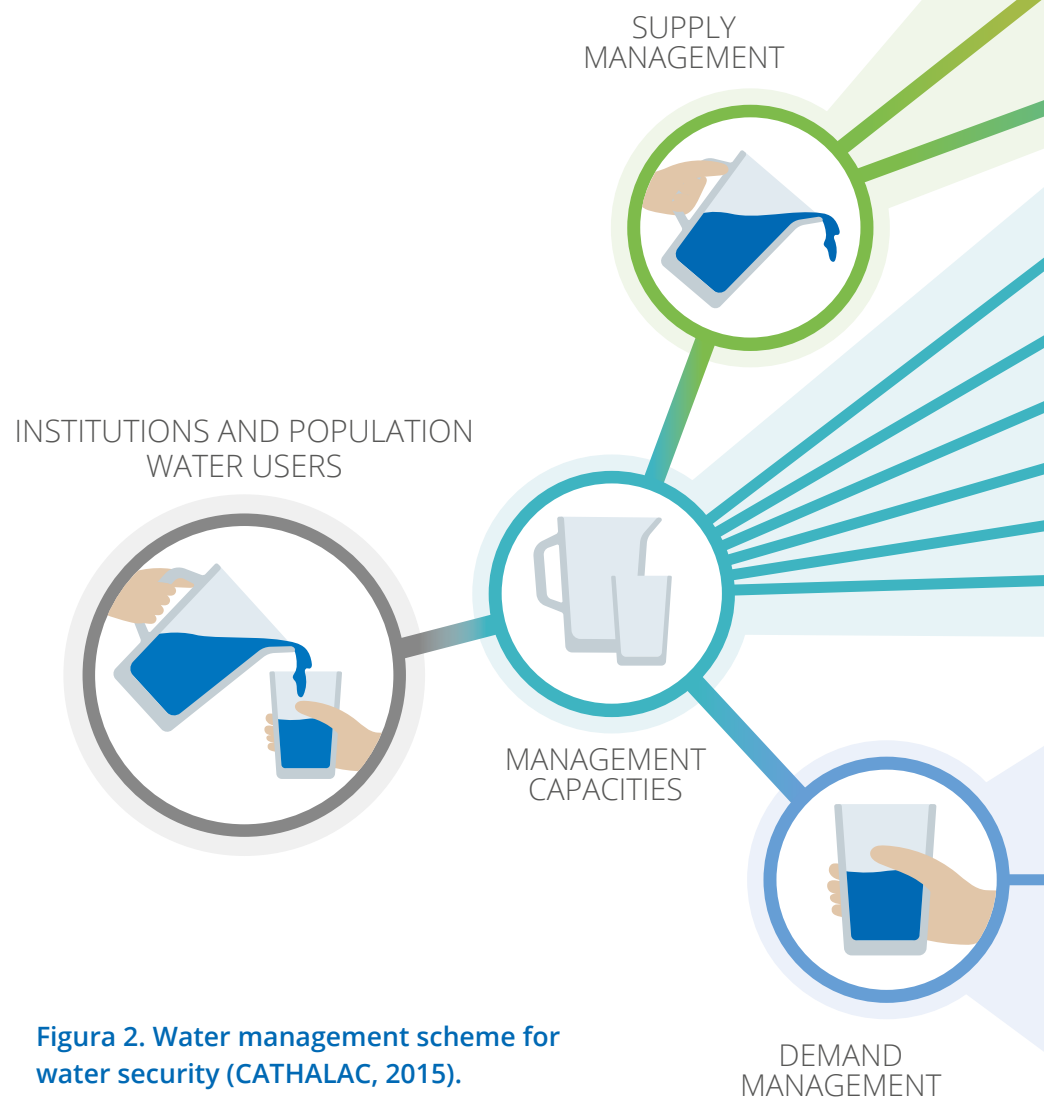
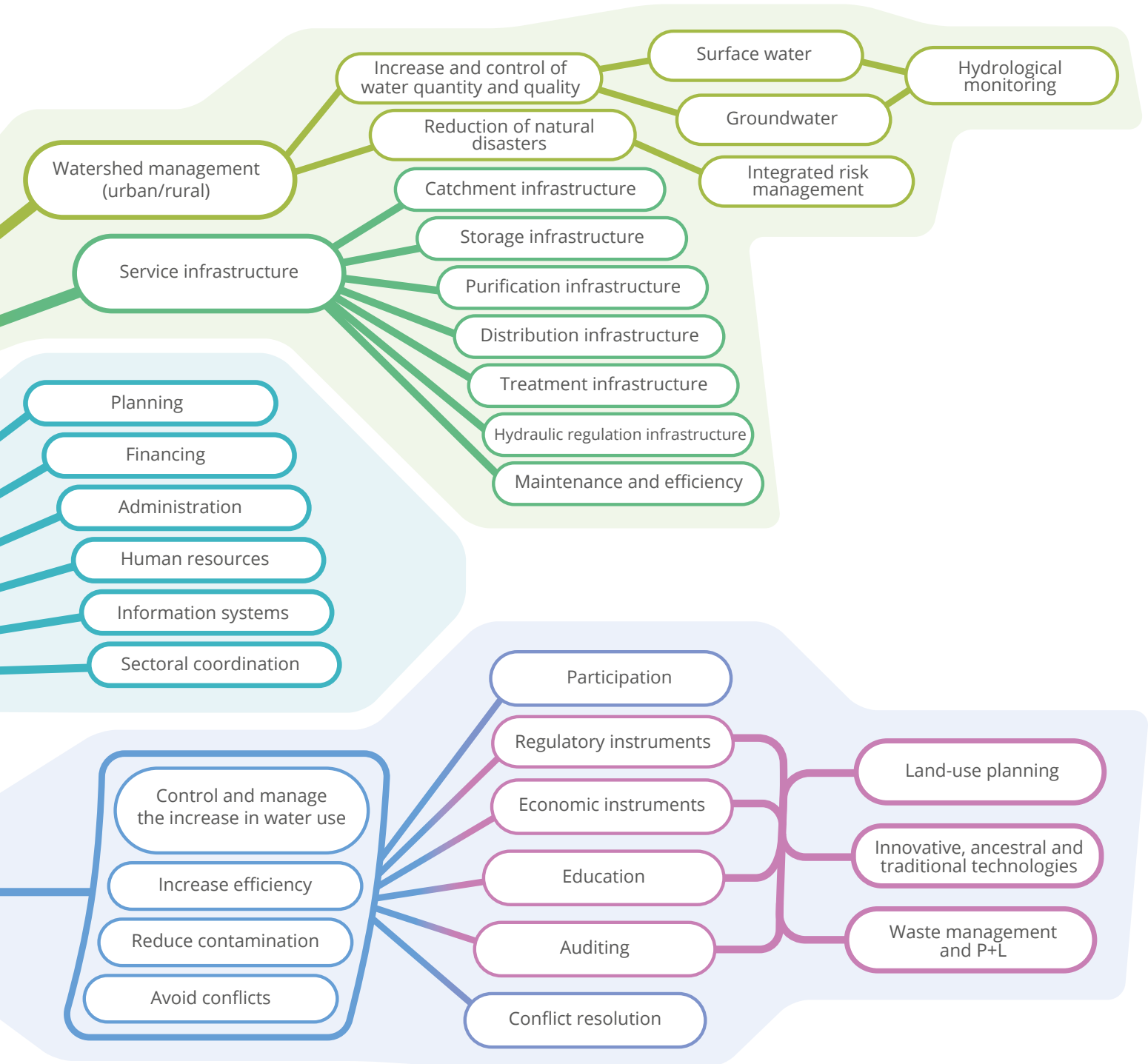


Figura 2. Water management scheme for water security (CATHALAC, 2015).





# Analysis of Public Policy Frameworks<sup>2</sup>

2 Based on Colom (2014).

Most countries in the region of Central America and the Caribbean have adopted legislation favoring water security, including the adoption of integrated water resources management and concrete measures to address climate change.

In both regions, the common denominator is both the public nature of water and the guarantee to private property, which means that water rights granted to non-governmental individuals or groups to use water or provide public services are protected by the constitution.

Insular countries with low water availability focus on the legal and institutional framework of public water and sanitation services, around which measures of risk management and adaptation to climate change are established.

Legislation of water as a resource is present in states that have a reasonable availability of fresh water and an area of over 10,000 km<sup>2</sup>, including Belize, Guyana, Jamaica, Suriname and all of the SICA states, which in turn also regulate public water and sanitation services and adopt measures for water conservation in watersheds.

As for conservation of water resources, the observed trend in recently issued water laws is to include the protection of the water in watersheds, such as in Honduras and Nicaragua, while Jamaica adopted this approach in 1963. Antigua and Barbuda, Dominica, Guyana, Jamaica, Suriname and all of the SICA states provide for measures for deterioration and pollution control, in legislation governing either water, public services or the environment.

All CARICOM and SICA states are part of the United Nations Framework Convention on Climate Change and the United Nations Convention to Combat Desertification and Drought. In terms of international watercourses and aquifers, no state has approved the Convention on International Watercourses for purposes other than navigation, which is justified in the case of the island states but not the SICA countries that share vast territories in common watersheds. This demands new solutions or different approaches to international water management.

Of the 22 states, only Costa Rica, Guatemala, Honduras, Nicaragua and Dominica have ratified ILO Convention 169 on Indigenous and Tribal Peoples; Antigua and Barbuda, Bahamas, Belize, Guyana, Jamaica, St. Vincent and the Grenadines, Trinidad and Tobago, Guatemala, El Salvador, Honduras, Nicaragua, Panama and the Dominican Republic have approved laws on access to information; and all the Central American states except Belize have passed the United Nations Convention against Corruption, while of the 15 Caribbean states, only the Dominican Republic, Grenada, Saint Kitts and Nevis, Saint Vincent and the Grenadines, Suriname and Montserrat are missing. As for citizen participation, the case of Guatemala stands out because by law, it integrates citizens into the formal planning and budget allocation process through the system of development councils organized at national, regional, municipal and community levels.

Decentralization and inclusion of local government in decision-making processes is a common feature of public policies in the SICA states, and is even defined by constitutional mandate in the case of Guatemala

and Honduras. A single model of water management in Central America has not been identified; some agencies are part of the environmental sector with legal and functional independence, as in Nicaragua and Honduras; others are part of a ministry or environmental authority, as in Costa Rica and Panama. Guatemala and El Salvador still manage water by sectors, without a governing authority.

In most countries, internal programs of decentralization and municipal strengthening have been developed in which international cooperation organizations such as the European Union and Inter-American Development Bank, among others, have in many cases participated. Among the different actors involved in these processes are the civil society, academia, business sectors and political representatives elected by popular vote.

Despite these valuable efforts, few studies have examined the implementation of laws and policies governing water resources within the decentralization processes of the countries of the region in the context of climate change. Therefore, this research breaks new ground in the comparative study of water management and adaptation to climate change at the local level in four municipalities - Santa Cruz Mulua and Quetzaltenango in the Samala River watershed in Guatemala, and Tamayo and Guayabal in the Yaque del Sur River watershed in the Dominican Republic.



# Municipal water security and adaptation measures<sup>3</sup>

3 Based on Morán, M., (2014).

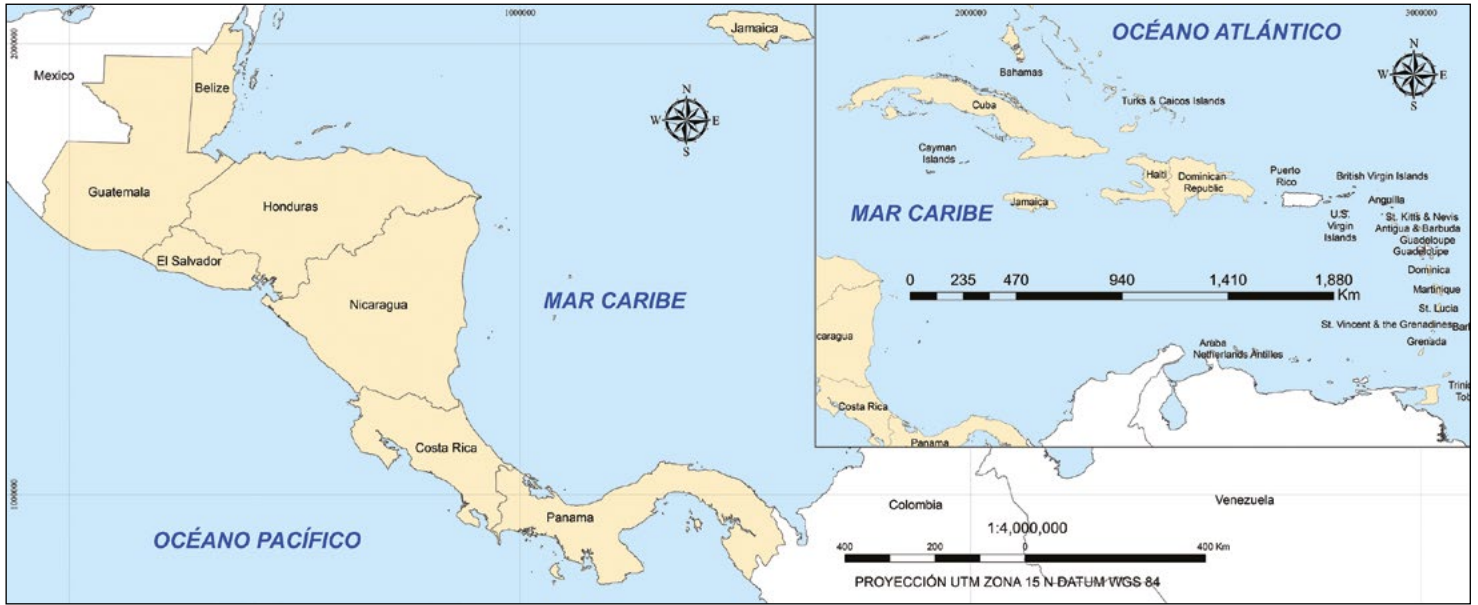
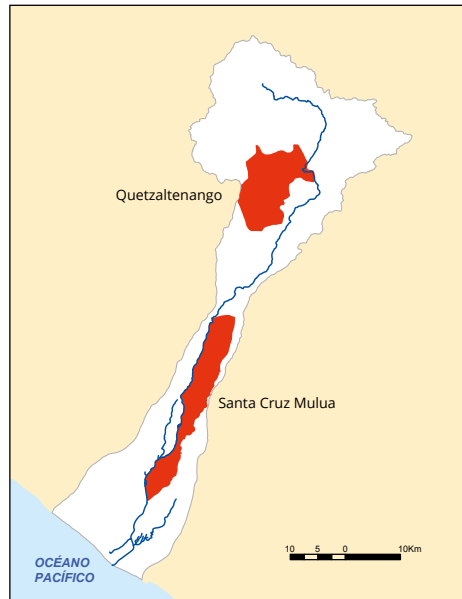


Figura 3. Maps of the study regions

The study included in-depth analysis of water management and water security in four municipalities located in two pilot watersheds selected in Guatemala and the Dominican Republic: the municipalities of Quetzaltenango and Santa Cruz Mulua in the upper and lower parts of the Samala River watershed; and the municipalities of Guayabal and Tamayo in the Yaque del Sur watershed in the Dominican Republic. In each of the watersheds, Focus Participation Groups were called together to discuss, validate and expand on the project results from a Participative Research and Action perspective.



In both countries, the opportunity exists to renew the water management framework through legal reforms. Although the importance of water resources is conducive to shared management by different sectors, this does not mean that it should be fragmented; in addition, approaches to water management have evolved towards integrated perspectives that give greater relevance to local governments. Moreover, the countries face new

challenges posed not only by population growth and the subsequent degradation and increased demand for natural goods and services, but also by more recurrent droughts, storms and other phenomena related to climate change.

Water security was evaluated through 30 indicators in four municipalities. The concept was divided into eight elements, as presented in Table 1.

Table 1. Water security indicators at the municipal level.

Water security element	Evaluation indicators
WATER SOURCES AND AVAILABILITY	<ul style="list-style-type: none"> <li>▶ Water availability</li> <li>▶ Degree of pollution and degradation of water sources</li> <li>▶ Forest cover</li> <li>▶ Territorial management plans/ watershed management ordinances</li> </ul>
WATER AND DEVELOPMENT	<ul style="list-style-type: none"> <li>▶ Relevance of water resources to the economy</li> <li>▶ Water use and water savings technologies in major uses</li> </ul>
SERVICES	<ul style="list-style-type: none"> <li>▶ Access to improved water sources</li> <li>▶ Quality of drinking water</li> <li>▶ Accessibility in price of water</li> <li>▶ Access to improved sanitation facilities</li> <li>▶ Solid waste management and disposal</li> <li>▶ Handling of hazardous and hospital waste</li> </ul>
HEALTH	<ul style="list-style-type: none"> <li>▶ Incidence rate of parasites and diarrhea</li> <li>▶ Incidence rate of dengue and malaria</li> </ul>
FOOD SECURITY	<ul style="list-style-type: none"> <li>▶ Incidence rate of malnutrition, anemia, low birth weight or stunted growth in children under 5 years old</li> <li>▶ Local food production</li> </ul>
ENERGY SECURITY	<ul style="list-style-type: none"> <li>▶ Access to electricity</li> <li>▶ Local availability of energy sources</li> </ul>
RISKS	<ul style="list-style-type: none"> <li>▶ Flood risk</li> <li>▶ Drought risk</li> <li>▶ Landslide risk</li> <li>▶ Windstorm risks (for the Dominican Republic) / frost (for Guatemala)</li> <li>▶ Community based organization for disasters</li> <li>▶ Accessibility during the rainy season and communication</li> <li>▶ Migration caused by hydro-meteorological risks</li> </ul>
GOVERNANCE	<ul style="list-style-type: none"> <li>▶ Legal security over water rights</li> <li>▶ Municipal participation in water management</li> <li>▶ Opportunities for agreements and participation</li> <li>▶ Transparency and availability of information</li> <li>▶ Water-related disputes</li> </ul>

It is clear that at the local level there are consequences from the gaps left or permitted by the higher levels: dramatic stories were found about the lack of drinking water at homes; pollution of sources due to the lack of sanitation and proper waste

disposal; vulnerability to water-related disasters; displacement of access to traditional water sources and its effects on health, access to education, development options and poverty. In response to the needs and available resources, municipal-

ities have developed an interesting variety of strategies and solutions for water management, constructed at the local level from the existing opportunities for each reality.



## Guatemala<sup>4</sup>

In Guatemala, the criteria for integrated water resources management and adaptation to climate change are incorporated in the form of guidelines into national planning, without a special plan for water security (Colom, 2014). Although the Law on Protection and Improvement of the Environment was ratified in 1986, the Executive Authority has yet to issue technical standards and/or regulations for environmental water management that include water management in watersheds. Currently, civil law establishes a general system for granting and recognizing water rights<sup>5</sup> which are not fully applied. Since there is no national registry of uses and registration of rights, water rights for energy and mining use granted under the General Electricity Law and the Mining Law are the cause of frequent conflicts among the users,

4 Based on Morán M. and Colom de Morán, 2015, Noack (2014) and Sur Futuro (2014 a and b).

5 Part of the Civil Code in effect, Legislative Decree 1932, effective for provisional article 124 of the Civil Code, Decree 163.

between these and local inhabitants, and in turn, between local inhabitants and the State, due to the lack of harmonization of sectoral policies, including those of rural development.

Despite these adverse conditions, municipal governments have made concerted efforts to strengthen the integrated management of water resources and to ensure water security within their jurisdictions. As described below, these efforts have been limited by lack of resources and opportunities, especially in rural municipalities without the assistance of international cooperation, such as Santa Cruz Mulua.

### Municipality of Quetzaltenango

In the municipality of Quetzaltenango, the contribution of international cooperation in water management is noticeable, always accompanied by a corps of committed technicians with important capacities, but above all, with a willingness to learn and

to continually improve. This technical team has enabled progress in achieving goals for water security as shown in Figure 3, but faces the challenge of continued growth in human capacities outside of the political context, and of coordinating actions in a broader territorial space than the municipality, i.e., focusing on watersheds. Tables 2 and 3 provide information on adaptation measures that have been suggested in relation to water security.

In Quetzaltenango City, the water supply remains under the responsibility of the Aguas de Xelaju Municipal Company (EMAX, for its acronym in Spanish). This company noted a decrease in water demand after a rate adjustment. However, rates remain distorted as the municipality provides electrical energy from its own generation plant. This subsidy gives the municipality the means to interfere in the company's autonomy to the extent of putting it at risk, e.g. in the HHRR processes, by the impossibility of developing better options for its personnel.



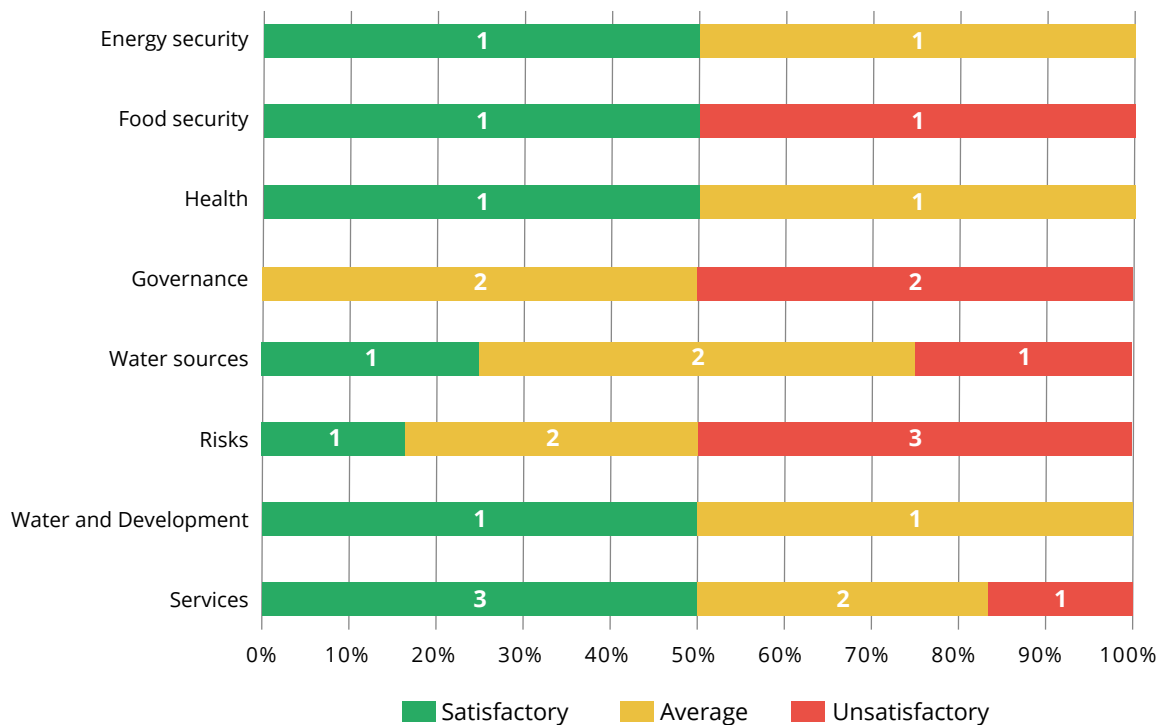


Figure 4. Water security index in the municipality of Quetzaltenango

Table 2. Number of adaptation measures per water security element prioritized in Quetzaltenango.

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

Table 3. Balance of adaptation measures in Integrated Water Resources Management in Quetzaltenango

CATEGORY	Total	Term	
		C	M
Legal-institutional framework	9	5	4
Spaces for participation	6	6	
Capacity building	10	4	6
Watershed and water source management	5	4	1
Infrastructure	4	2	2
Risk management	5	4	1
Demand management	9	9	
<b>TOTAL</b>	<b>48</b>	<b>34</b>	<b>14</b>

## Municipality of Santa Cruz Mulua

Access to drinking water in Santa Cruz Mulua has improved consistently in recent years. In part, this progress has been driven by the mayor, with his knowledge of construction work and committed work ethic. In addition, the official national planning scheme offered the mechanism needed to advance the outdated water systems. The improvement included a rate and charge for the service, but unfortu-

nately there is still no mechanism to reinvest in the same service. In the area of sanitation, the municipality is limited by not having land to locate a treatment plant, a situation for which a joint solution could be explored.

In this municipality, 69% of the population engages in agricultural activities. However, in 2008, 855 women and 231 men in the munic-

pality were treated for malnutrition; moreover, 35% of children under five (5) have a moderate height deficit, and 7% have a severe deficit. This is because the most productive area of development is based on crops such as rubber, fruit and sugarcane, which are not necessarily for local consumption; combined with very poor breastfeeding practices and eating habits.

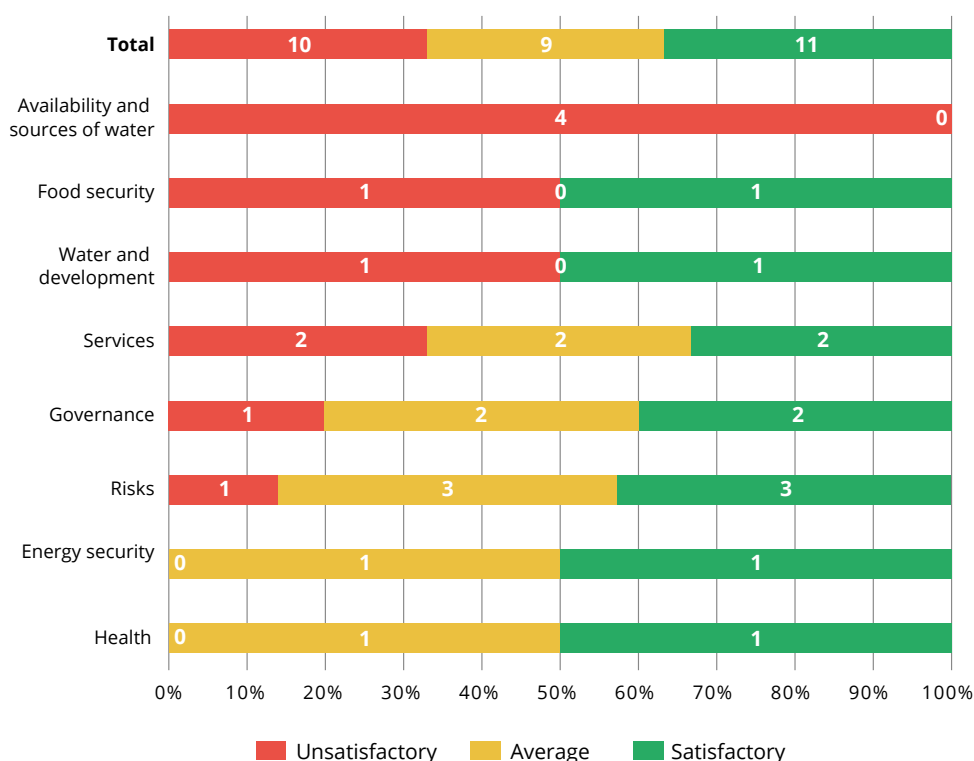


Figure 5. Water security index in the municipality of Santa Cruz Mulua

Table 4. Number of adaptation measures per element for water security prioritized in Santa Cruz Mulua

Type of Measures	Term			Sources	Services	Governance	Water and development	Risks	Total
	Short	Medium	Long						
Capacity Building	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									
<b>Total</b>	<b>17</b>	<b>13</b>	<b>0</b>	<b>6</b>	<b>9</b>	<b>5</b>	<b>6</b>	<b>4</b>	<b>30</b>



## Dominican Republic

In the Dominican Republic, the National Development Strategy, which is a Law of the Republic, is the vehicle of synergy between special water policies and climate change (Colom, 2014). Financial studies (Sur Futuro, 2014a) indicate that nearly three quarters of the investment made by the Dominican Republic in the area of water has to do with supplying potable water and sanitation, and especially infrastructure construction (investment flows). Although investment continues to grow year after year, World Bank<sup>6</sup> and CEPALSTAT<sup>7</sup> statistics and studies by Otañez and Diaz (2011) point out that the gap in the shortage has progressed, suggesting the need to revise the potable water management model.

The watershed approach is recognized in the Dominican Republic, although water management has

been geared towards engineering and infrastructure solutions which, while representing an important physical capital and a stronghold for water security, must be complemented with solutions aimed at protecting soil and water sources, as well as regulatory, economic and educational instruments.

In the Dominican Republic, the Community Rural Aqueduct Associations, known as ASOCAR (for their acronym in Spanish), are charged with operating and maintaining water supply systems, including charging fees for water services. The topic of decentralization is also interesting in that

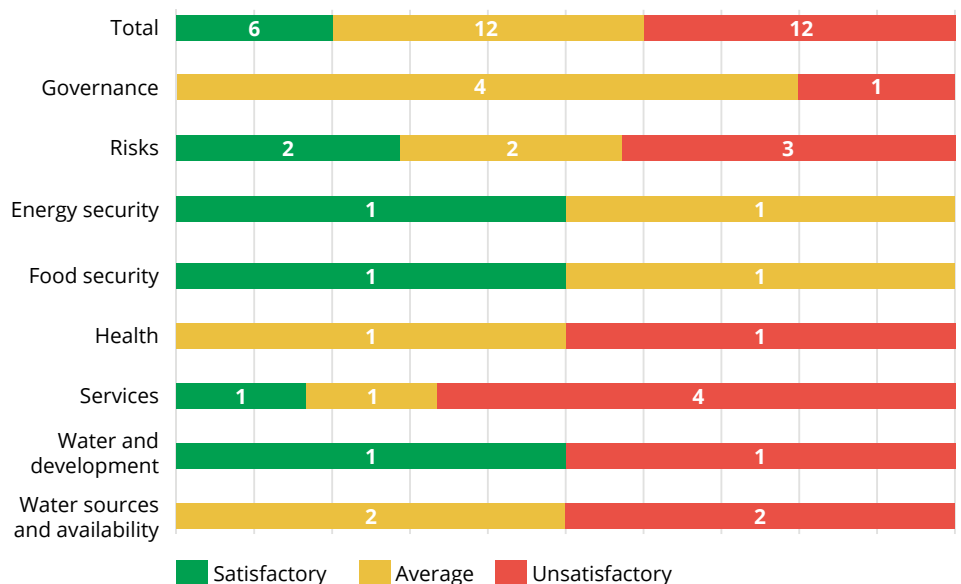


Figure 6. Water security index in the Municipality of Tamayo

<sup>6</sup> <http://datos.bancomundial.org/indicador/SH.H2O.SAFE.ZS>. Calculation for the years 2000 to 2012.

<sup>7</sup> <http://interwp.cepal.org/sisgen/ConsultarIntegrada.asp?idIndicador=97&idioma=e>



the National Institute of Hydraulic Resources (INDRHI, for its acronym in Spanish) in the Dominican Republic delegates functions to the Irrigation Boards. Organized as private organizations to make decisions about water management in local irrigation systems, these Boards are an appropriate space to realize IWRM, but the water committees must be articulated to the public administration system and their function must be recognized and systematically supported by the central and municipal governments.

### Municipality of Tamayo

The municipality of Tamayo in the Dominican Republic faces the continual challenge of answering to the population's demands for water supply and sanitation, but without maintaining proper coordination with the centralized State institution.

There are frequent reports in the area of gastrointestinal and vector-borne diseases (dengue, chikungunya) and high levels of infant mortality, while reports indicate weaknesses in the sanitation, drainage and waste disposal systems. The frequent flooding that affects the city is also related to the operation of the drainage systems.

On the other hand, the municipality of Tamayo is known for the leadership and credibility of its numerous peasant, neighborhood and community associations, which have promoted the presence of public entities. For example, the population recognizes the need for pre- and post-disaster organization, with public-private partnerships also being essential in these cases.

Table 5. Summary of the adaptation measures for the municipality of Tamayo

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

### Municipality of Guayabal

Guayabal, located in the upper part of the Yaque del Sur watershed, has a challenge in terms of communication: few households have telephones and very few have internet; radio coverage is weak and communication with the outside world is constantly interrupted due to flooding, causing subsequent food and supply shortages. Through the mayor's lobbying, the National Government has invested in the construction of a bridge over the

river, providing some relief to the population.

In Padre las Casas, a municipality near Guayabal, the work of the Catholic Church has been fundamental, as has been other activities such as medical research, support to peasant organizations, project counseling, as well as media support to bring an end to a wave of mortality linked to contaminated drinking water and unsanitary conditions.

Table 6. Summary of the adaptation measures for the municipality of Guayabal

	Services	Water and development	Water Sources	Total
Supply				
Watersheds			4	4
Infrastructure	3	2		5
Demand			6	6
Capacities	1		1	2

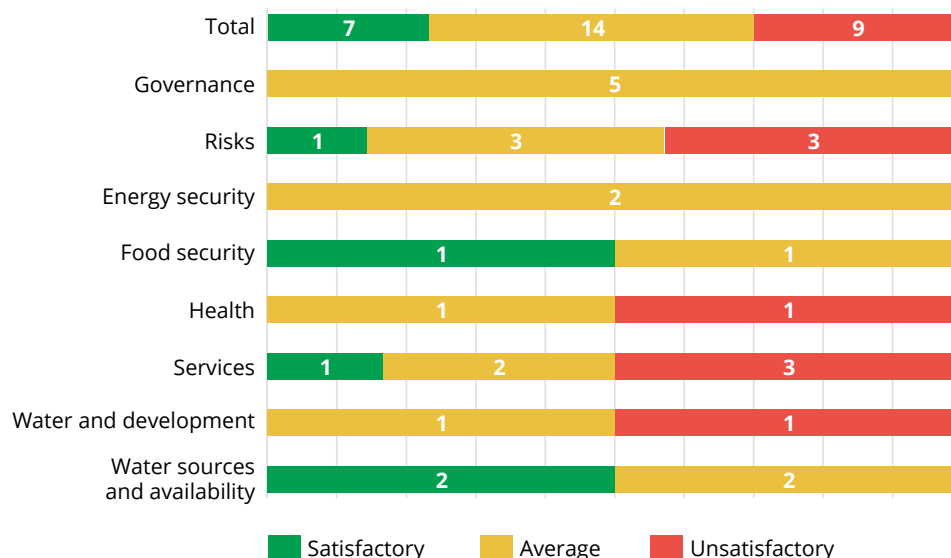


Figure 7. Water security index in the municipality of Guayabal

# ANALYSIS AND SYNTHESIS OF THE RESULTS OF THE CASE STUDIES

Guatemala and the Dominican Republic provide a significant difference in terms of water security which has to do with the level of responsibility given to municipalities, namely, the degree of decentralization of functions. While in most of the Dominican Republic, a centralized drinking water and sanitation entity (National Institute of Water Supply and Sewerage) operates, in Guatemala this responsibility has been delegated entirely to the municipalities. Despite this important difference, the results in terms of water coverage and sanitation are not so dissimilar, with only a few exceptions. In both cases, there is a gap in the regulation of the quality of services.

In both countries, the limited availability of information may restrict the management responses of those involved; additionally, if water rates are poorly designed, users are not stimulated to save. In general, the lack of data on the presence, quality and use of water has unfortunate consequences that are not easily visualized in terms of losses from natural disasters, economic losses due to lower benefits provided by resources as they deteriorate, and in the end, more challenges to reducing poverty.

Both countries have good tools for planning measures for adaptation to climate change, but their implementation is uneven among sectors; in both countries it is essential to consider future climate variables in the construction and roadway

communication sector.

In regard to water, difficult struggles were found to exist between the large and small, the rich and poor. Due to their representation, economic profits and importance as employment generators, corporations monopolize water resources. Sometimes they also pollute or degrade ecosystems, leaving almost no voice to small producers and local communities, which in many cases are disorganized and have little leadership. Insufficient attention often radicalizes protest groups, making it imperative that the principles of sustainable development and equity become effective starting at the highest political level and permeating all of government, especially through supportive and fair mechanisms for resolving conflicts.

In both countries, the municipal authorities have the political power to influence local decision-making and are entitled to act on behalf of the community, and also show strong interest in water management and climate change; but they are given low importance and have limited resources to take action. These authorities need support in order to promote empowerment, training, and identification and implementation of sustainable solutions as well as real adaptation measures.

As in many parts of the world, water committees, mainly in rural and suburban areas, play a key role as providers of public water and sanitation. Initially, the committees arise due to the lack of state response to demands for access to basic services; they then assume a leading role in promoting access to

and improvement of services, and participate in investment and in organizing users to fully assume the technical, administrative and financial responsibility for operating and maintaining services, even setting standards and service fees.

A solution, especially in rural areas, usually comes from productive associations and private or international organizations. However, sometimes water systems are undersupplied because these same productive associations divert waterways for the irrigation of high value and export crops, which places the interested groups in an unequal bargaining position. Moreover, the resultant pollution tends to affect the water quality of the systems, so there are many opportunities for companies to contribute positively in water management; not only in irrigation systems by making them more efficient and giving maintenance to the canals, but also by reducing the use of agrochemicals, making better use of water in wash tubs, waste management and other similar measures.

Empirical evidence suggests that wastewater generally is not treated and institutional capacities to control it are very limited. This situation affects the health and quality of life of the population, especially those who obtain their supplies directly from natural sources and/or live in poverty.

In all the contexts analyzed, the demand for people to have greater sensitivity to environmental issues was constant, which means that the role of environmental education needs to be elevated, revising the methods and scope.

As in many government areas, the implementation and enforcement of laws is an enormous challenge, especially when it comes to maintaining common resources in such broad spaces, as in the case of forest preservation. Therefore, the complaint of not having enough monitoring staff and not applying the appropriate sanctions constantly arises. This suggests the use of standards of collective action in institutions as proposed by Ostrom (1990), where the participants of the institution (in this case, forest management) would be responsible for monitoring and enforcing their own rules established by a specific procedure previously agreed upon.

At the local level, many capacities are required to solve specific and everyday problems and to resolve conflicts. Also, adaptation plans that tend to reduce vulnerability to climate change are needed, as well as the necessary statistical information and the budget to meet the challenges of ensuring water security.

All of the above reveals that despite the many challenges, there is no single key to improving conditions for water security, but through local effort and engagement it is possible to find alternatives to resolve delays and seize opportunities, as well as numerous opportunities for external actors to accompany and contribute to the advance of local development.

## Implementation of measures for water resource management at different scales

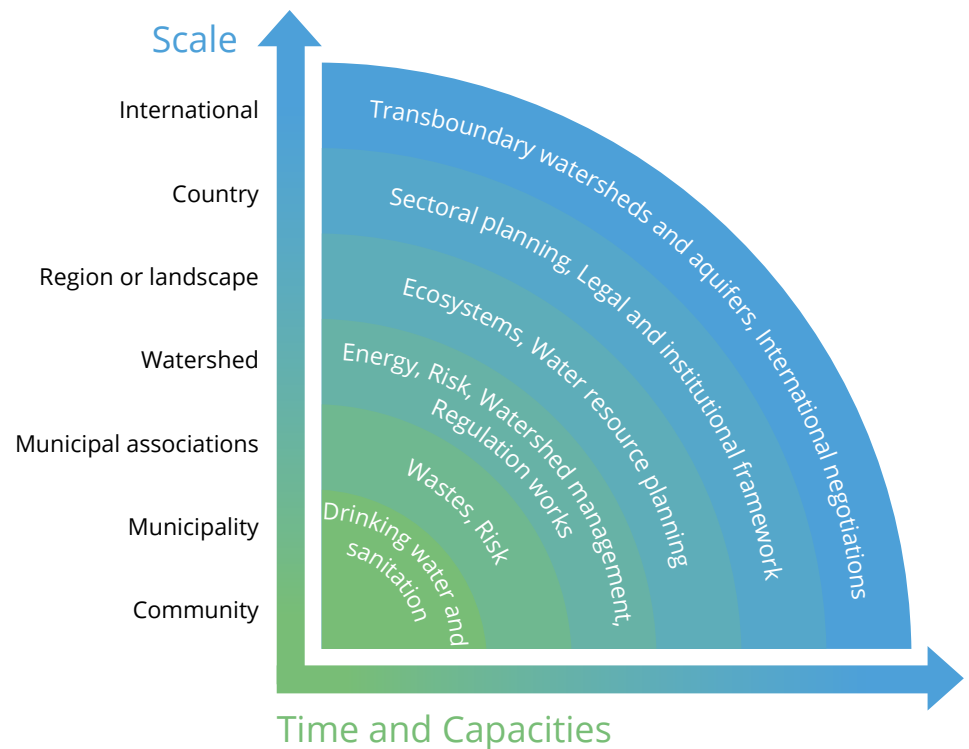


Figure 8. Scales of investment in water security (Moran and Colom, 2015)

Figure 8 presents a graph where the y axis shows different geographical scales, while the x axis shows a progressive increase in capacity over time. In the graph, different aspects of water security can be seen by spatial groupings.

The strategy of considering different geographical scales in which to address different actions will provide greater sustainability to the measures, optimization of investments, efficient use of public resources, legitimacy to the stakeholders and empowerment by the population.



For example, it has been suggested that the provision of drinking water services can be resolved in the lowest or most decentralized administrative units, which would require strengthening of local capacities, for example, taking advantage of the opportunities offered by municipal development agencies while favoring close relations and coordination with the centralized units.

The issue of waste can be managed along with other administrative units, especially in neighboring municipalities, municipal associations or metropolitan areas.

Watersheds are recognized as the management unit par excellence due to the natural process of water circulation, which facilitates, enables and economizes the development

of water infrastructure for multiple purposes, from the conservation of sources to risk mitigation, irrigation infrastructure, power generation, and others. Management at this level is facilitated by watershed agencies.

Continuing with the scheme, structural aspects such as institutional design and legal framework are built on larger scales by the various national government bodies, always applying spaces for consultation. However, in order for local stakeholders to achieve informed participation and make a valuable contribution, it is necessary for them to share a common language with both technical and axiological bases.

Finally, at the international level, regional or transnational watershed

agreements are negotiated; actions to mitigate greenhouse gases also have impacts on the water sector, as well as reducing the global water footprint.

Management of each element of water security involves progressive capacity building in planning, social participation, information systems, environmental education, inter-institutional coordination, hydrological monitoring, research, regulation and control, infrastructure development and conflict resolution strategies. All of these aspects are addressed in detail in the publication *La Gestión del Agua para la Seguridad Hídrica frente al Cambio Climático [Water Management for Water Security in the face of Climate Change]* (CATHALAC 2015).

## RECOMMENDATIONS

Adopt an innovative Integrated Water Resources Management (IWRM) approach to ensure water security in the process of adaptation to climate change. It is recommended that national institutions consider both the water supply and demand in the proposed policy brief. (See Figure 1).

Support the decentralization of water management and local provision of water and sanitation services through the support and strengthening of municipal capacities to assume these responsibilities, including water balance estimations, demand management and the resolution of conflicts between different users.

Support local water committees so that they articulate with the public administration system and their roles are recognized and supported systematically by the central and municipal governments.

The analysis of the elements of water security from a global, national, watershed- and all the way down to the municipal level, as well as a detailed analysis of Integrated Water Resources Management (IWRM) as a methodological approach for achieving water security, have clearly demonstrated that the solutions required in the various elements of water security may be associated with different geographical scales, with diverse advantages associated with each area of intervention.

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**Water security** is understood as the degree of success a given population has over their water management. UN-Water (2013) defines it 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”.



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