APPLYING THE WATER GOVERNANCE FRAMEWORK ON RURAL WATER DEVELOPMENT PROJECTS IN GUATEMALA

by

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A Thesis Submitted in

Partial Fulfillment of the

Requirements for the Degree of

Master of Science

in Freshwater Sciences and Technology

at

The University of Wisconsin-Milwaukee

May 2016

ABSTRACT

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The University of Wisconsin-Milwaukee, 2016
Under the Supervision of Professor Jenny Kehl

According to the Organization for Economic Cooperation and Development (OECD), 'Water crisis is mainly a governance crisis', (OECD, 2013). Many water experts, as individuals, organizations and even governmental bodies have developed water governance frameworks to overcome water challenges on local, national, and international levels such as Integrated Water Resource Management. In rural areas, especially in developing countries, access to safe drinking water is a daily challenge due to a variety of political, economic, and social constraints. For instance, some developing countries have a strong centralized governance system. Due to lack of capacity and resources, central governments are incapable of providing water services to communities in rural areas located farther from amenities. At the same time, decentralization, as an alternative governance framework, does not guarantee meeting the needs of rural communities. The devolution of power from central government to local authority requires individuals who have the requisite information and the incentives as well as the capacity to bear responsibility for the political and economic consequences of their decisions. Furthermore, local authorities may

face the threat of being controlled and overthrown by local elite groups who could exploit the power to achieve personal goals.

In 2011, OECD developed a water governance framework (WGF) to better manage the water sector and evaluate gaps within water governance mainly on governmental levels. These include measuring the policy gap, accountability gap, funding gap, information gap, administrative gap, objective gap, and capacity gap. The WGF has been applied in many different regions across the globe in national and sub-national levels of governments. In 2015, OECD updated the WGF based on feedback obtained from various organizations that used the framework.

This study applies the OECD WGF to water projects completed in Guatemala by the Student Chapter of Engineers Without Borders at the University of Wisconsin-Milwaukee (EWB@UWM). This work represents a reciprocal testing of the WGF as well as water development projects in Guatemala. The reciprocal testing investigates the validity of applying this particular water governance framework on small scale community-based water projects. In other words, this study aims to test the applicability of the WGF on rural development projects and determine strengths and weaknesses of the framework. On the other hand, this study explores the ability of rural communities to effectively utilize the WGF to identify their water policy gaps.

In addition to the main anticipated outcomes that are mentioned above, the merit of this study is to help external groups, such as EWB@UWM, apply the WGF to evaluate their completed water projects that are installed in rural areas. Moreover, it helps local in-country partners (individuals and organizations), as well as communities to better utilize the framework, measure the gaps in their local capacity, and communicate their needs in order that their future is sustainable.

In January 2016, site visits took place to five out of the seven projects that are being analyzed. Additionally, interviews were conducted with the cofounder of EWB@UWM, Dr. Marissa Jablonski, as well as the head of EWB@UWM's in-country partner, La Asociación de Comités Comunitarios Medio Ambiental de la Región Ixil (ACCMARI), Mr. Diego Ramirez. The outcome of the site visits and the interviews are used to identify water policy gaps in the water projects of Guatemala. More specifically, the OECD WGF addresses seven different gaps which are based on 12 principles. The site visits and interviews indicated that four out of 12 principles cannot be applied on the water systems. Therefore, these four principles are eliminated from the analysis.

Hence, eight variables are identified to investigate any gaps present in the completed projects. Each principle is measured through a set of questions which examines that particular principle. Each question is rated with a score from 0-10, whereas the score of a certain principle is the average score of all answers. If a principle has a score of less than '5', then a water policy gap is present. The administrative gap is eliminated from the analysis because it does not apply to the water systems being analyzed. The other six WGF gaps are assigned to the eight principles that were discussed in section 7.3. Four gaps are assigned to one specific principle whereas the other two gaps, each one of them is assigned to two principles.

The structure of this paper starts with a brief introduction, followed by chapter 2 that illustrates the specification of the project (statement of problem, statement of significance, anticipated outcome, and research questions). Later on, extensive literature review is presented which discusses rural development works and focuses on political and economic variables. After that, the paper presents the methodology used to conduct this research, the analysis and discussion

sections, ending with a set of policy implications and guidelines regarding the communities as well as the OECD WGF.

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1.0 Introduction

In the past few decades, there has been a lot of international funding towards financing the water sector especially in the developing countries. Developed countries, international aid organizations, and donors have invested considerable amounts of money for rural water development (Haller et al, 2007). The main purpose was to supply the poor, who lack access to water services in developing countries, with safe drinking water. Apart from inadequate funding, there have been major obstacles and challenges that hindered implementing water policies that aim to supply safe drinking water to rural communities (Ashley and Maxwell, 2001). For instance, extreme poverty in many rural areas have been a major challenge for operating and maintaining water systems, especially after the external groups leave the area upon completion of the project. Poverty can be a limitation for managing and maintaining water projects sustainably. As a result, water systems may become unable to provide the intended services any longer (Chenoweth, 2008). The technology used in water systems can play a key role in determining the efficiency of the system. In many cases, it is the donors who choose what technology the community needs without any consultation with the users. If the technology does not suit the community for reasons of tradition or culture, there may be an objection for using the system, and the needs of the people will stay unsatisfied (Harey et al, 2007).

The lack of understanding of the political and economic conditions presents a major hindrance towards sustainable rural water development. Full realization and consideration of the existing political and economic circumstances are inevitably required. Failing to do so may result in delivering water services that may not meet people's water demand (Eaton, 2001). If this trend of misunderstanding communities' needs continues, future rural development will continue to be

unsatisfactory for the water system's users (Clasen, 2009). If the political and economic challenges are not overcome, it is very unlikely for international efforts to be successful in terms of improving the delivery of water services (Rietveld et al, 2009). A better conception of these settings would pave the road towards more comprehensive approaches that could bring services to beneficiaries efficiently and sustainably. Furthermore, it could assist in mapping out details of planning, design, and implementation of water supply systems due to deeper understanding of the reality of local inhabitants in rural areas.

The main goal of this research is to apply the Water Governance Framework (WGF) developed by the Organization for Economic Cooperation and Development (OECD). The framework is applied on seven water projects completed by the Student Chapter of Engineers Without Borders at the University of Wisconsin – Milwaukee (EWB@UWM). All projects have been installed and completed in Northwest Highlands of Guatemala.

Several indicators are used to quantitatively measure the principles of the framework in order to identify water policy gaps. The analysis is based on calculating an average score per principle through conducting a set of questions that examines each principle. The score of each principle is obtained by calculating the average of the scores of all questions. In other words, each principle is examined by questions whereas each question is rated on a scale from 0-10. A water policy gap is identified where a principle score (i.e. average score of all answers) is below '5'. The main purpose of measuring the principle is to help identify water policy gaps. The administrative gap is eliminated from the analysis because it does not apply to the water systems being analyzed. The other six WGF gaps are assigned to the eight principles that were discussed in section 7.3. Four gaps are assigned to one specific principle whereas the other two gaps, each one of them is assigned to two principles..

2.0 Project Specification

The following four sub-sections give a brief summary of the specification of this project. The first section describes the problems associated with water governance in rural areas and identifies gaps in international water development works. The second section addresses the significance of this work and how and who can benefit from this analysis. The third section shows the anticipated outcomes of this project. The fourth section lists the research questions this work is attempting to answer.

2.1 Statement of Problem

Water demand has significantly increased in the last few decades because of population growth, as well as a new lifestyle that requires higher water supply. In addition, industrial and agricultural development has increased the exhaustion of water resources (Rijsberman, 2006). Therefore, the stress on water resources has enlarged the gap between water supply and demand, thus, water has become a scarce resource in many regions around the globe.

Particularly in rural areas, securing daily water demand is a major challenge. Unlike other commodities, such as oil or electronic devices, water cannot be feasibly transported from one place to another over thousands of miles on a daily basis to bridge the deficit in water-short regions (Postel et al, 1996). Water scarcity can exist even when water is available because lack of infrastructure contributes to water scarcity (Pereira et al, 2009). According to Bardhan (2002), any governmental or international interventions must be a response to the felt needs of the people who lack access to safe drinking water in rural areas in the developing world.

Currently, policies and frameworks in place fail to supply water in a sustainable manner to marginalized communities. One of the most prominent factors is the misunderstanding of the

political, economic, and social conditions of a certain community. This in turn hinders water policy and obstructs rural water development outcomes.

2.2 Statement of Significance

The merit of this study is to step beyond existing knowledge regarding water policies and water governance frameworks. Moreover, it aims to investigate the OECD Water Governance Framework, updated and published in October 2015, and its applicability to identify water policy gaps in the water systems installed in Guatemala. This study performs a reciprocal testing of the WGF and the completed water projects in Guatemala. The reciprocal testing investigates the validity of applying this particular water governance framework on small scale community-based water projects. In other words, this study aims to test the applicability of the WGF on rural development projects and determine strengths and weaknesses of the framework. On the other hand, this study explores the ability of rural communities to effectively utilize the WGF to identify their water policy gaps.

The application of the framework is through investigating various political, economic, and social variables. Moreover, this study assesses the framework in terms of conditions under which this framework can be applied. Finally, it explores how the WGF can contribute to providing sustainable access and sufficient quality of water to rural areas. Indeed, the leading purpose behind this effort is to light the path towards overcoming the global water crisis.

2.3 Anticipated Outcome

As mentioned above, the WGF was released in October 2015. Researchers and water experts, including OECD's partners, are starting to apply the WGF in different regions of the world in order to verify the WGF and ensure its usefulness. This work represents an attempt to under-

stand the framework and how it can function under different political, economic, and social conditions when it is applied on small scale community-based water projects. Essentially, the WGF is proposed to analyze water policy on a governmental level. However, this work focuses on small projects rather than large projects.

The main anticipated outcome is to provide feedback to the OECD regarding the applicability of the WGF in order for them to refine their standards and criteria. This effort determines successes and failures when the WGF is tasked to identify gaps in water development works. Furthermore, this research offers a set of guidelines about how to best utilize the WGF optimally to rural communities, external groups, and other stakeholders involved in the water development sector.

It is vitally important for groups such as the Student Chapter of Engineers Without Borders at the University of Wisconsin-Milwaukee (EWB@UWM) to have a tool that can be used to evaluate their completed water projects. The methodological approach conducted in this research can be applied to future projects that will be implemented in the same region in order to help the EWB@UWM group and the served communities. Moreover, EWB@UWM and other external groups can identify water policy gaps regarding previous projects, address what caused these gaps, and eventually work towards bridging the present water gaps through collaborative, cooperative and communicative work with communities.

3.0 Research Questions

1. How can the OECD WGF identify water policy gaps (water access, water quantity, and water quality) in rural water development?
    a. What are the water policy gaps examined in the OECD WGF?
    b. How can water policy gaps be addressed?
    c. What tools and information are required to identify water policy gaps?

2. Under what conditions does the OECD WGF succeed in identifying water policy gaps?
    a. What are the political, economic, and social variables that have an impact on the success of rural water development?
    b. What are the limitations for the OECD WGF which hinder its effectiveness in assessing rural water projects?

3. Can the WGF indicators measure sustainability of water projects in rural areas?
    a. How is sustainability defined according to the WGF?
    b. According to the framework, can a project be sustainable and at the same time have a certain water policy gap?
    c. How many years after completion are required to clearly assess sustainability?

4.0 Literature Review

In September 2000, following the Millennium Summit of the United Nations, 193 countries had committed to helping achieve the Millennium Development Goals -MDG- by year 2015. The MDGs intended to increase the living standards through setting 8 goals such as eradicating extreme poverty, promoting gender equality, reducing child mortality and others. In March 2012, both the United Nations International Children's Emergency Fund (UNICEF) and the World Health Organization (WHO) have announced that the MDG concerning halving the population without access to safe drinking water has been met (UNICEF, 2012). According to the Millennium Development Goals Report (United Nations, 2015), 1.9 billion people, among the 2.3 billion people who have gained access to safe drinking water since 1990, have been using piped drinking water supply on premises (Figure 1). However, it is still a long journey until water supply can be available and affordable to everyone across the world. In fact, around 2.5 billion people do not have access to safe sanitation systems and 780 million do not have access to safe drinking water. Furthermore, it is estimated that 2 to 5 million people, mainly children, die annually because of water-related diseases (Gleick and Ajami, 2014; United Nations, 2010).

Figure 1: MDG progress since 1990

Source: United Nations, 2015

Water is essential for maintaining human survival. If the minimum amount of water was not provided, drinking and sanitation needs would not be satisfied. The WHO requires a person to have 2 liters per day in the Guidelines for Drinking Water Quality. The recommended two liters per capita per day are to compensate the water loss due to evaporation from the skin, excursion and respiratory tract losses (Gleick, 1996). However, supplying the minimum amount of water to meet the drinking purposes would not, by any means, allow for social or economic development.

4.1 Basic Water Needs

There has been a long discussion among water scholars and experts about determining the minimum amount of water required for human well-being and economic and social development. The WHO has recommended 20 liters per capita per day as a minimum requirement of water for domestic hygiene purposes (UNICEF, 2000). Gleick (1996) showed that 50 liters per capita per day would be sufficient to meet the domestic needs. He derived this figure as he noted 5 liters per capita per day are required for drinking, 20 liters per capita per day are required for sanitation, 15 liters per capita per day are required for bathing, and 10 liters per capita per day are required for food preparation. A more conservative estimate is, 7.5 liters per capita per day can be sufficient to meet the daily basic consumptive needs (Howard and Bartram, 2003). However, the authors noted that 7.5 liters per capita per day cannot entirely meet the hygienic needs. Therefore, they claimed that 50 liters per capita per day can meet most the water needs and a 100 liters per capita per day will satisfy all the water basic needs (Chenoweth, 2008).

There have been enormous efforts by water experts and international organizations, such as the WHO, to estimate the minimum amount of water required per capita. However, there is a significant variation among recommended measures. These differences come from different

methodological approaches taken by researchers. Additionally, some recommendations were based on experiments that took place in different regions in the world, therefore the recommended amounts of water should only be applied to those regions. Climatic conditions, human behavior, geography and other factors can play a major role in determining the minimum water needs for the household. Understanding the community's characteristics regarding individual's behavior, community activities, and the socio-economic dynamics is the key role for defining, and later on meeting the water needs of rural communities.

Water is used for different purposes by different sectors of society. Water use depends on various factors such as culture, tradition, religion, technology, lifestyle and many others. According to the groundbreaking work of White and Bradley (1972), water uses were conceptually categorized as:

- **Consumption use** such as using water for drinking and cooking purposes.
- **Hygiene use** such as using water for bathing, washing and cleaning purposes.
- **Amenities use** such as using water for watering lawns, car washing and other purposes.

The book of White and Bradley (1972), *Drawers of Water* (DOW), described the domestic water use in East Africa; Uganda, Tanzania and Kenya. They found that the mean daily water consumption to be 38.7 liters per capita. However, water consumption varied depending on the region, and more significantly, on whether or not the household is piped or unpiped. On average, piped households used water around 3 times the quantity unpiped households used (Figure 2). Likewise, households in urban locations used considerably more water compared to those located in rural areas, which still holds true today.

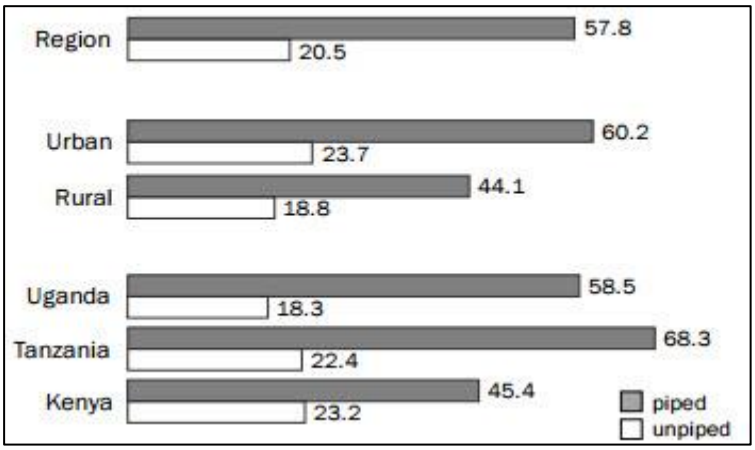

Figure 2: Water use variation based on country and service

Source: Thompson and Munguti (2001)

Thompson and Munguti (2001) carried out a follow-up study (DOW II) on the original DOW communities. They used the same methodology of DOW to ideally determine how the situation changed over the past three decades. They concluded that the quantity of water consumption was almost constant at the surveyed households, roughly 4 liters per capita per day (Figure 3). In other words, there was no statistical variation in water consumption among users of piped and unpiped households across the three countries of Kenya, Uganda and Tanzania concerning consumptive use. On the contrary, results showed that unpiped households suffered enormously compared to piped households (see figure 4). The low levels of hygiene are the consequence of the dearth of water in unpiped households available for washing, bathing and cleaning. For disadvantaged unpiped communities, quantity of water is highly val-

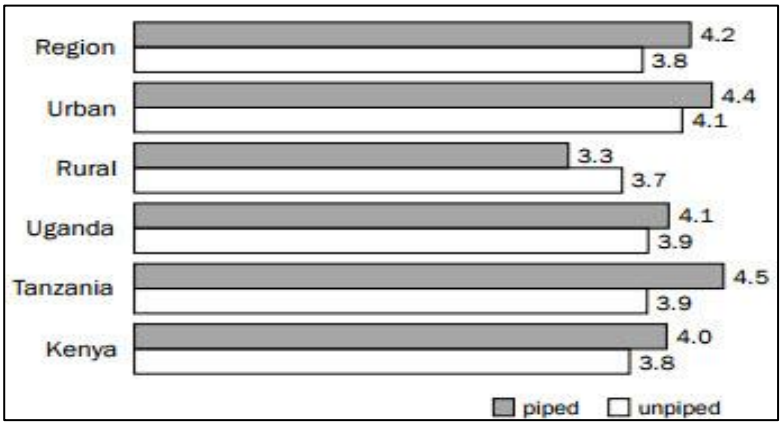

Figure 3: Water used for Consumptive Use. Units are in Liters

Source: Thompson and Munguti (2001)

ued compared to quality of water since many diseases can transfer through hands, food, uncleansed dishes. These diseases are more likely to be water-washed than water-borne. Hence, inadequate amount of water devoted for hygienic purposes make the health of a person deteriorated (White and Bradley, 1972).

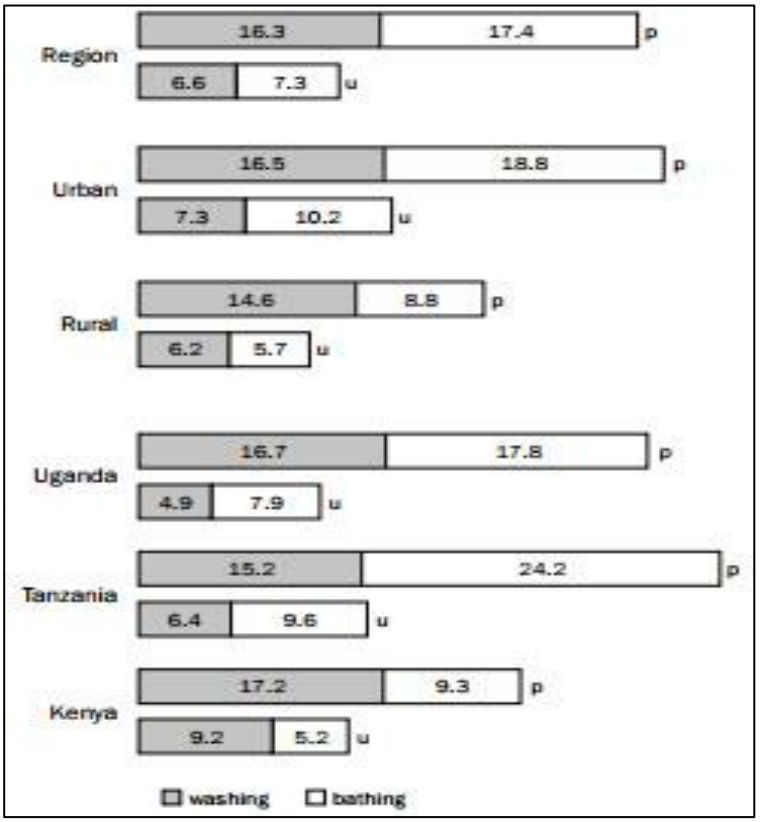

Figure 4: Water used for Hygiene Purposes

Units are in liters. Source: Thompson and Munguti (2001)

4.2 Political Constraints Facing Rural Water Development

For the last few decades, international efforts have been focused on rural development. However, poverty in rural areas has been persistent as well as the limited funding that continued to be failing to meet the goal of supplying safe water to the poor (Ashley and Maxwell, 2001). The term 'rural' is ambiguous. According to Ashley and Maxwell, rural areas constitute ''the space where human settlement and infrastructure occupy only small patches of the landscape, most of which is dominated by fields and pastures, woods and forest, water, mountain and desert. They are also places where most people spend most of their working time on farms; where land is abundant and cheap; where transaction costs are high; and where political conditions are most difficult'' (2001). Figure 5 shows the urban and rural population levels in the developing countries from 1950 to 2020. Due to many reasons, such as poverty, slow economic growth, and poor infrastructure, inhabitants of rural areas migrate to urban areas. This population shift has several significant effects on both areas. For instance, rural areas will change in terms of demography, social classes and structure, and most importantly, local economy will lose some potential to grow (Young, 2013).

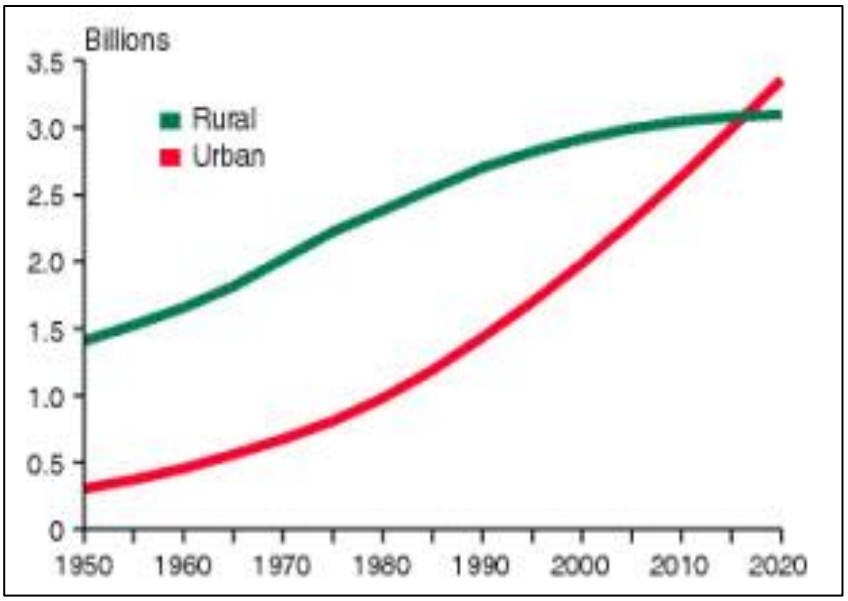

Figure 5:Urban and rural population levels in developing countries, 1950-2020

Source: Pinstrup-Andersen et al, 1999

During the last 30 years, there has been a strong debate over governance forms (Centralization versus Decentralization) and which framework would lead to a more sustainable economic growth and stability for urban and rural regions. Each framework has its own strengths and weaknesses. It is reasonable to argue that in regard to service deliveries and local development, people who have the requisite information and the incentives as well as the capacity to bear responsibility for the political and economic consequences of their decisions should have control rights in the governance structure. Arguably, this requires devolution of power from the central government to local authorities. However, in the developing world, local governments may face the threat of being controlled by local elite groups who might deviate from the goal of delivering services to the general public in the community. Hence, for the decentralization approach to be effective, the social structure in these communities should be modified to guarantee the engagement of the marginalized minorities (Treisman, 1999).

Dufhues et al, view decentralization as an approach to better incorporate the interests and hopes of local residents in rural areas despite the fact that public participation on a local level cannot be guaranteed by decentralization (2014). Another drawback of decentralization is corruption. The devolution of power may enhance keeping corruption at bay. In order to overcome this issue, there should be a supervisory body that would effectively monitor bureaucrats' behaviors (Lessmann and Markwardt, 2010). It is vitally important to realize that the reasoning behind decentralization is not to weaken the central authorities, nor to allow for elite groups to govern, but rather it is about meeting the felt needs of the large majority of the population by making governance at the local level more responsive and effective (Bardhan, 2002).

Political scientists have shown that moving from centralization to decentralization can refer to a variety of motives. For instance, decentralization can be a voluntary decision by politi-

cians in the central government as they believe it can increase economic growth and political stability in a way that compensates the politicians if they lose any power in the short run. Some countries would move to decentralization to deepen the principles of democracy and to strengthen civil society. Another motive for moving towards decentralization is to off-load some of the responsibility onto lower levels of government (Manor, 1999). Moreover, according to Willis et al (1999), sub-national politicians may exert pressure on national representatives so that they are coerced to move towards decentralization. For instance, in 1980s, when the states' governors in Brazil regained political influence, the return to democracy allowed for fiscal decentralization across the Brazilian states. Furthermore, decentralization can be used as a tool by politician for short-term gains (Eaton, 2001).

A major goal for decentralization is to achieve sustainable development where the central government is incapable of doing so. Societal consensus is an important factor in the implementation process to achieve sustainability. Therefore, grassroots support is essential. However, in many countries, decentralization has been implemented as a top-down affair instead of bottom-up as a result of the grassroots pressure. One other drawback of decentralization is the continuous struggle between politicians and bureaucrats over how decentralization should be implemented. Many countries have had this struggle such as India, Kenya, Sri Lanka, and Morocco (Shah and Chaudhry, 2004).

Decentralization and centralization as governance frameworks have their own benefits and negatives. In the past few decades, many developing countries have moved towards decentralization in order to obtain sustainable development in rural areas. Countries like India and China that have enormous populations extended over vast land area have devolved central powers to rural communities. Central governments, in such cases, could be a constraint for rural de-

velopment due to the considerable efforts that are needed to meet the felt needs of poor communities. In this case, decentralization allows for better management that guarantees, to a certain extent, sustainable development.

Many governments in the developing world are incapable of providing water supply services to rural areas due to various resource constraints which have resulted in the adoption of community managed rural water supply (Harvey and Reed, 2007). Community managed rural water supply aim to engage the community by allowing the community members to participate in the planning process. The adoption of community managed rural water supply has begun since the early 1980s (McCommon et al, 1990). Since then, there has been a shift in paradigm towards bottom-up approach. This approach values the importance of engaging the marginalized minorities in rural areas as well as basing the decision making process on the local participation (Garnade and Dagg, 2004). Local participation has gained a significant support by the international community which has declared The Dublin Statement (1992), the Hague Declaration (2000) and the 2003 Water Forum (Waithaka, 2013).

Churchill et al (1987) have contributed a significant effort to improve efficiency in water rural development projects. They fundamentally provided guidelines to effectively plan and manage community managed water rural systems. The major guidelines in their report, Rural Water Supply and Sanitation: Time for a Change, have focused on the community role to preserve sustainability. They called for collaboration across different sectors of government, international aid organizations and donors and adhered to the principle that ‘‘it is the local people themselves, not those trying to help them, who have the most important role. The community itself must be the primary decision maker, the primary investor, the primary maintainer, the primary organizer, and the primary overseer’’ (Harvey, 2007). The guiding force for water rural

development should be the local ability and community's willingness to commit resources from the planning through the implantation phases. Local choices should prevail regarding design, technology, or any other relevant concern if there happened to be a conflict of decisions with the outsider experts (Harvey, 2007). Additionally, it is important to mobilize the financial and non-financial resources of a community so that the community will have a sense of ownership and control over the water system. This will bring the community closer to the point where the locals are fully capable of covering all the associated costs for maintenance and operation (Rondinelli, 1991). Furthermore, there has to be a redefinition of institutional responsibilities so that institutions across the globe will become more consistent with the role of governments, international aid organizations and agencies (Churchill, 1987).

Rural development goes beyond what the outsider thinks is best for the community. Rural development is a multidimensional process that ranges from individual's income, public provision of goods, and access to common property resources to other significant issues such as self-respect and autonomy (Razavi, 1999). The case of tribes, Vasava and Tadvi, in Gujarat, India draws a clear example for how well-being is tightly related to water. The two tribes were forcibly resettled 200 kilometers away from their original home due to a reservoir flooding at River Narmada in early 1990s. The tribes' members were considered backward by the dominant groups who have been living in these villages. Indian officials predicted that women would become developed since they have access to water taps within a range of meters. Unfortunately, this was not the case. In fact, women preferred the river water as it tasted better. Moreover, they desired the freedom to access water from the river rather than waiting for officials to turn on the tap (Mehta and Punja, 2006). The traditional intervention by the Indian officials led to dramatic changes in various matters such as water quantity and quality. As a result, the resettled tribes suf-

fered considerably from the intervention's implications on their daily livelihoods and routine, social and cultural identity as well as social relations as described above. Officials, bureaucrats and policy makers had only focused on the superficial understanding of the relationship between water and well-being. Thus, tribes' needs and well-being have been worsened by not integrating and engaging the tribes in the decision making process (Mehta, 2014).

The political constraints for water rural development are mainly represented in the governance system. Decentralization has shown reliability in terms of sustainability if implementation adopted the bottom-up approach. The bottom-up approach should ensure local participation and meet the needs of the inhabitants of marginalized communities in rural regions. The decentralization framework can be the solution for governments that are incapable of providing water services to farther communities. It is worth mentioning that central governments should be committed to offering technical assistance and supervision to rural communities in order to make sure that decentralized water systems are meeting the needs of the beneficiaries.

4.3 Economic Constraints Facing Rural Water Development

Alongside the political governance constraints, economics play a dynamic role in supplying water to rural communities. Economic variables can be an obstacle facing the implementation and management of community managed water systems. For instance, low income levels of local inhabitants can prevent them from maintaining their water systems. Thus, access to safe drinking water could be seriously threatened.

In wealthy country, there is a significant budget allocated to guarantee reliable household water supply. On the contrary, poorer countries, especially in rural areas, locals rely on limited water distribution systems. Unfortunately, this is due to the unsustainable intervention that does

not last long enough. Low levels of income of local inhabitants can worsen the situation in these poor areas (Schouten and Moriarty, 2003). Rietveld et al (2009) have conducted a technical assessment on rural water systems in South Africa. They studied 15 villages that have improved water supply. They found that three villages did not have adequate water supply because their wells had dried up. During the day of inspection, five villages did not have any water – the water pumps had been broken in two villages, two villages did not have money to buy diesel for the water pumps, and the last one had its pump operator ill. Poverty in such communities significantly impacts the water systems in the operation and maintenance phases. In Bangladesh, for instance, only 64% of the international interventions were functional regarding water supplies and arsenic mitigation technologies (Kabir and Howard, 2007).

The harsh financial situations, the inhabitants of rural areas in the developing world face, have been a major obstacle for managing the community water systems. This refers to the fact that the recovered revenue by locals cannot cover the associated costs with the water systems such as the necessary operational and maintenance costs. Hence, a significant number of community managed water systems are found malfunctioned or deteriorated (Hunter et al, 2010). It has been a controversial debate among policy scholars about requiring households to pay for their community managed water systems. Generally, the beneficiaries of the water systems are required to cover a proportion of the capital cost in addition to the operation and maintenance costs. Clearly, rural inhabitants of the communities that are not served with water systems are considered as the poorest of the poor. Therefore, a payment, even if small, for water services would be a considerable burden (Whittington et al, 2008).

Another reason behind the objection to charging the users for water services is the expected positive health externality resulted from the provision of improved water services. Thus,

according to Whittington et al, (2008), ‘‘a traditional economic efficiency criterion calls for the use of a Pigouvian subsidy to equate marginal social benefits with marginal social costs.’’ Similarly, Sachs (2005) supports that argument of supplying water services to rural communities free of charge. Sachs' rationale is that poor people in rural communities are trapped in an atrocious cycle of degraded health, lack of education, poor economic productivity. The provision of water services may break out this cycle and allow the community to establish a fertile environment for economic growth.

In consideration of the poor's level of income, it is challenging to set a tariff for the water services provided to poor communities in rural areas. In the past, considering the low income levels of local inhabitants, tariffs were set at levels below the actual costs of operation and maintenance of the water system. Hence, inadequate investments coming from below-cost charges would result in deteriorating the water system and that, in turn, would make the beneficiaries object to pay these low tariffs for the service anymore (Alexander, 2005).

As mentioned above, poverty and low-income levels can be a challenge to operate and maintain the community water systems. However, some NGOs and international donors argue that the community is yet capable to manage the non-pecuniary costs. For instance, community members are more likely able to contribute time and labor to implementing and installing their water systems. This proposal, that has not been controversial, believes that the community can cover the human resource costs (Kleemeier, 2000).

Internationally, there is a wide criticism regarding allocated budgets to finance water sector in the developing nations. This criticism comes from the perspective of inadequate funding and underutilization of the donated money. In order to meet the water and sanitation targets of

the MDG, a budget of US$11.3 has been allocated annually (United Nations, 2015). This amount, that is not much in terms of how many dollars are invested per person annually, is pretty feasible for many donating countries. Moreover, it is estimated that US$84 billion is the accrued economic benefits of meeting the MDGs. This is about seven-fold return (Stockholm International Water Institute, 2005).

Haller et al (2007) conducted a study aiming to estimate the costs and benefits of water and sanitation improvements at global level. They have discovered that for every US$1 spent on investments in water services, UD$5 to US$46 are predicted as an economic return. They have also indicated that the highest revenue rate comes from least-developed regions. The biggest contribution to this revenue comes from saving time and energy by having reliable water systems in proximity with the household (Carter and Bevan, 2008).

Other studies have also showed that providing safe water and improving water services minimize poverty. This argument goes beyond reducing costs regarding health care. Hanjra and Gichuki (2008) have argued that water and sanitation interventions lead to provide adequate water supply which is an essential prerequisite to economic development. According to Stockholm International Water Institute (2005), the annual economic growth is only 0.1% in poor communities that lack access to improved water service whereas communities with approximately same income per capita but with access to improved water services experience 3.7% as an average annual economic growth (Hunter et al, 2010).

5.0 Theory and Variables:

5.1 OECD Development Efforts

For many years, water experts have referred to the global water crisis as a governance problem. According to the United Nations, governance is defined as ‘‘the exercise of economic, political, and administrative authority to manage a country’s affairs at all levels...it comprises the mechanisms, processes and institutions through which citizens and groups articulate their interests, exercise their legal rights, meet their obligations and mediate their differences.’’ (Global Water Partnership, 2002). Water governance particularly refers to an array of political, economic, social, and administrative systems that are integrated to manage and develop water bodies and resources in order to deliver water services to the society (Rogers and Hall, 2003). In other words, (Moench et al, 2003) define water governance as a framework that regulates the decision-making process concerning water resource development and management. Hence, water governance is not all about the policy outcome or the decisions themselves, rather it is about the approach it takes to make these decisions.

The Organization for Economic Co-operation and Development (OECD) describes water governance as ‘‘the set of rules, practices, and processes through which decisions for the management of water resources and services are taken and implemented, and decision-makers are held accountable’’ (OECD (c), 2015). In order to attain an effective water governance framework, it is vitally necessary to establish an environment that facilitates efficient initiatives proposed by private and public sectors. To achieve that, a comprehensible legal framework should be in place with a powerful and independent regulatory regime (Global Water Partnership, 2000).

In 2011, OECD highlighted that the global water crisis is a governance crisis in its report ''*Water Governance in OECD Countries: a Multi-level Approach*.'' It also indicated that solving the water crisis is not about finding the technical, financial, or the institutional solutions; rather it is a matter of implementing these solutions (OECD, 2011). OECD stresses that the main obstacle towards sustainable water governance is the current governance gaps that hinder water policy. The second main challenge is the lack of monitoring economic, social, and environmental outcomes. Finally, OECD indicated that it is essential to engage all stakeholders at all levels to take part in designing and implementing place-based policies (OECD, 2013). To achieve that, 300+ contributors, represented in national governments, local authorities, international and local organizations, donors, individuals, researchers, and many others, worked on defining six good governance targets (Table 1) in 2012.

Table 1: The final synthesis report on good governance from the 6th World Water Forum.

Source: OECD, 2013

Good Governance Targets defined for the 6th WWF, Marseille 12-17 2012

Effective public governance	Target 1	By 2015, 50% of countries will have adopted **consultation, participation and coordination mechanisms allowing stakeholders at local, regional, national and international levels to effectively contribute to decision-making** in a coherent, holistic and integrated way. By 2021, 100% will have done so.
	Target 2	By 2015, 50% countries will have strengthened **regulatory frameworks** and adopted **performance indicators** (service delivery) to monitor and evaluate water policies; and all countries will have put in place **capacity-building processes** at national and local level to foster good governance in service delivery. By 2018, all countries will have done so.
Integrated water resources management	Target 3	By 2021, increase by 30% the number of **river basin management plans** (analysis of initial status and main issues).
	Target 4	By 2015, increase the number of countries with **water security diagnoses and governance tools**, based on existing (local, national, international) regulatory and legislative frameworks and integrated water resources management mechanisms.
Better integrity and transparency	Target 5	By 2018, 30 countries will have committed to promote **integrity** in the water sector, diagnose/map existing or potential **corruption risks**, and ensure that **anti-corruption policies** are well implemented and effective.
	Target 6	By 2018, 30 countries will be implementing: **transparent water budget processes**, including information about **water infrastructure investment planning and implementation** (financial, technical, and socioeconomic impacts); and methods and tools for improving **transparency and accountability** within the water sector.

The Final Synthesis Report on Good Governance from the 6th World Water Forum can be accessed at http://www.oecd.org/gov/regional-policy/Report_CG_CS1_Good_Governance_EN.pdf

Additionally, efforts were focused on designing realistic action plans that aim to engage stakeholders, improve integrated water resources management principles, and alleviate corruption through developing transparent budgetary processes (World Water Forum, 2012).

The OECD Water Governance Initiative has offered a platform for various stakeholders to take part in this initiative. Stakeholders can be within the water sector or outside. This platform was provided for stakeholders to share their experiences, successful and unsuccessful stories, and lessons learned in order to improve water governance (OECD, 2013). The main objectives of the Water Governance Initiative include (Figure 6):

- ‘‘**Advise governments** in taking the needed steps for effective water governance reforms through policy dialogue across decision-makers at different levels;
- Provide a **technical platform** to discuss analytical work on water governance through peer-to-peer exchanges and knowledge sharing;
- Provide a **consultation mechanism** to raise the profile of governance issues in the Global Water Agenda;
- Support the implementation of the governance targets designed for the 6th World Water Forum (Marseille, 2012) up to the **7th World Water Forum** (Korea, 2015); and
- Contribute to the preparation of **OECD Principles on Water Governance** and **OECD Indicators on Water Governance** to engage decision-makers at all levels, within and outside the water sector.’’

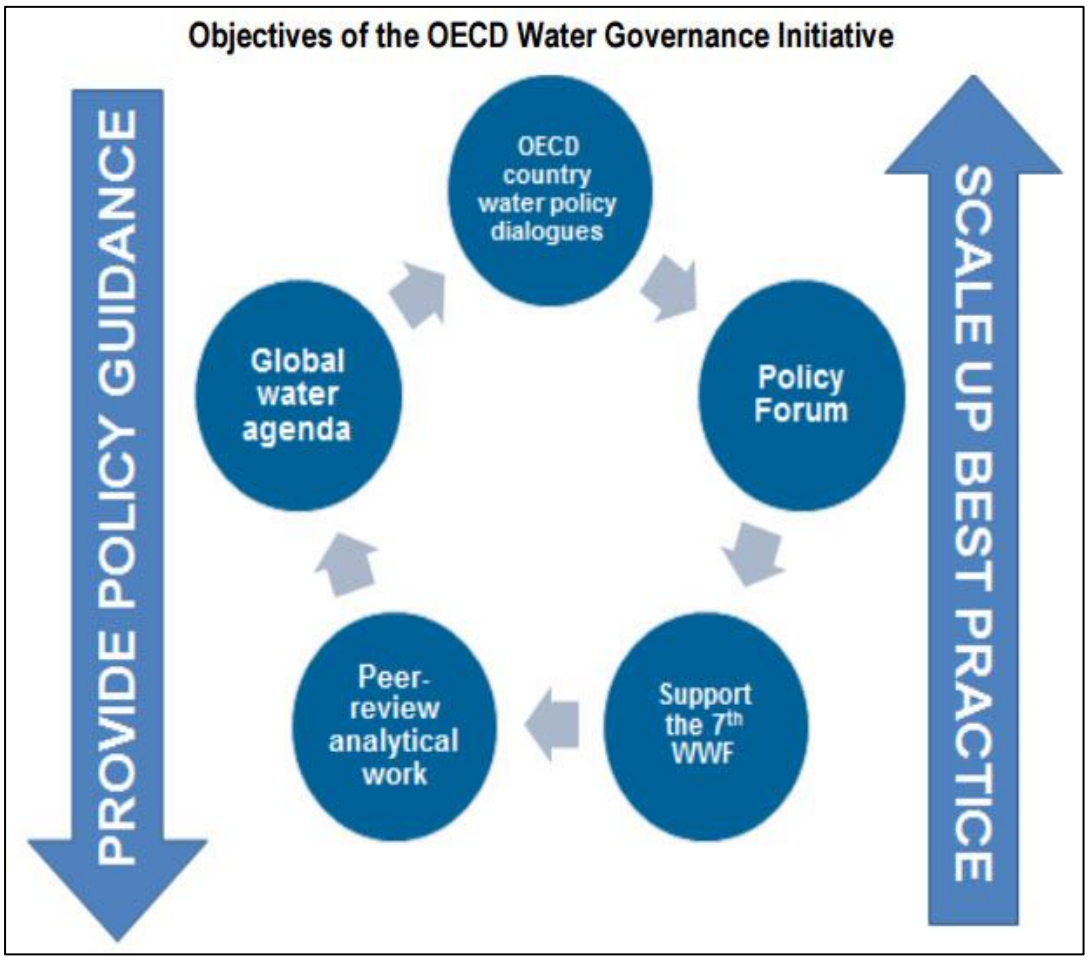

Figure 6: Objectives of the OECD Water Governance Initiative

Source: OECD, 2013

5.2 OECD Water Governance Framework

Since 2010, OECD has been exploring governance gaps that hinder the design and implementation of water policy. Hence, it has proposed a set of policy responses and good practices to overcome these gaps. As a result, OECD has developed a framework called ‘‘*OECD Multi-level Governance Framework: Mind the Gaps, Bridge the Gaps*.’’ The framework serves as an analytical tool for policymakers to make appropriate decisions to bridge policy gaps and overcome governance challenges. The OECD Multi-Level Governance framework (Figure 7) has been applied to 17 OECD countries in 2011, 13 Latin American Countries in 2012, Mexico in 2013, the Netherlands and Jordan in 2014, and Brazil in 2015.

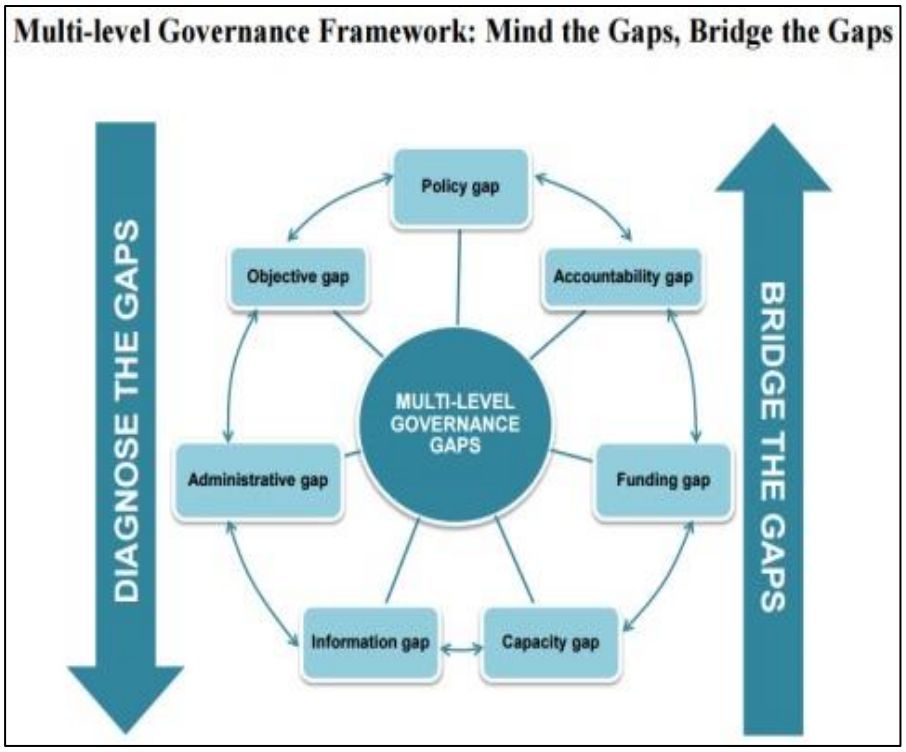

Figure 7: The Water Governance Framework

Source: OECD (b), 2015

It is vitally important to understand that this framework does not provide a one-size-fits-all solution to the global water challenges. Therefore, OECD offers a wide variety and large diversity of conditions, circumstances, and situations within and across countries. Thus, ‘‘governance responses should therefore be adapted to territorial specificities, and recognizing that governance is highly context-dependent and important to fit water policies to places’’ (OECD (b), 2015).

As mentioned above, the OECD Multi-level Governance Framework aims to bridge the gaps in water policy. Table 2 below describes the seven key coordination gaps: Administration Gap, Information Gap, Policy Gap, Capacity Gap, Funding Gap, Objective Gap, and Accountability Gap.

Table 2: Key Co-ordination Gaps in Water Policy

Source: OECD, 2011

The OECD Multi-level Governance Framework: Key Co-ordination Gaps in Water Policy	
Administrative Gap	Geographical ‘‘mismatch’’ between hydrological and administrative boundaries. This can be at the origin of resource and supply gaps. ➔ **Need for instruments to reach effective size and appropriate scale.**
Information Gap	Asymmetries of information (quantity, quality, type) between different stakeholders involved in water policy, either voluntary or not. ➔ **Need for instruments for revealing and sharing information.**
Policy Gap	Sectorial fragmentation of water-related tasks across ministries and agencies. ➔ **Need for mechanisms to create multidimensional/systemic approaches, and to exercise political leadership and commitment.**
Capacity Gap	Insufficient scientific, technical, infrastructural capacity of local actors to design and implement water policies (size and quality of infrastructure, etc.) as well as relevant strategies. ➔ **Need for instruments to build local capacity.**
Funding Gap	Unstable or insufficient revenues undermining effective implementation of water responsibilities at subnational level, cross-sectorial policies, and investments requires. ➔ **Need for shared financing mechanisms.**
Objective Gap	Different rationales creating obstacles for adopting convergent targets, especially in case of motivational gap (referring to the problems reducing the political will to engage substantially in organizing the water sector). ➔ **Need for instruments to align objectives.**
Accountability Gap	Difficulty ensuring the transparency of practices across the different constituencies, mainly due to insufficient users’ commitment, lack of concern, awareness, and participation. ➔ **Need for institutional quality instruments.** ➔ **Need for instruments to strengthen the integrity framework at the local level.** ➔ **Need for instruments to enhance citizen involvement.**

5.3 Water Governance Framework Principles

The OECD Multi-level Governance Framework developed 12 Principles on the premise that water challenges cannot be overcome by applying one particular solution to the worldwide water crises. Thus, the OECD Principles provide a wide variety of options that are based on the diversity of legal, institutional, administrative, and organizational systems within and across countries. According to (OECD (b), 2015), ‘‘the Principles aim to enhance water governance systems that help manage “too much”, “too little” and “too polluted” water in a sustainable, integrated and inclusive way, at an acceptable cost, and in a reasonable time-frame. They consider that governance is good if it can help to solve key water challenges, using a combination of bottom-up and top-down processes while fostering constructive state-society relations. It is bad if it generates undue transaction costs and does not respond to place-based needs.’’

The OECD Principles are based on three dimensions of water governance that are mutually reinforcing and complementary. These dimensions aim to guarantee concrete public policy outcomes. The three water governance dimensions are (OECD (d), 2015):

- ‘‘**Effectiveness** of water governance relates to *the contribution of governance to define clear sustainable water policy goals and targets at different levels of government, to implement those policy goals, and to meet expected objectives or targets*.
- **Efficiency** of water governance relates to *the contribution of governance to maximize the benefits of sustainable water management and welfare at the least cost to society*.
- **Trust and Engagement** in water governance relate to *the contribution of governance to building public confidence and ensuring inclusiveness of stakeholders through democratic legitimacy and fairness for society at large*.’’

The 12 Principles proposed by OECD are clustered around the previously mentioned three dimensions (see figure 9). The Principles are listed below:

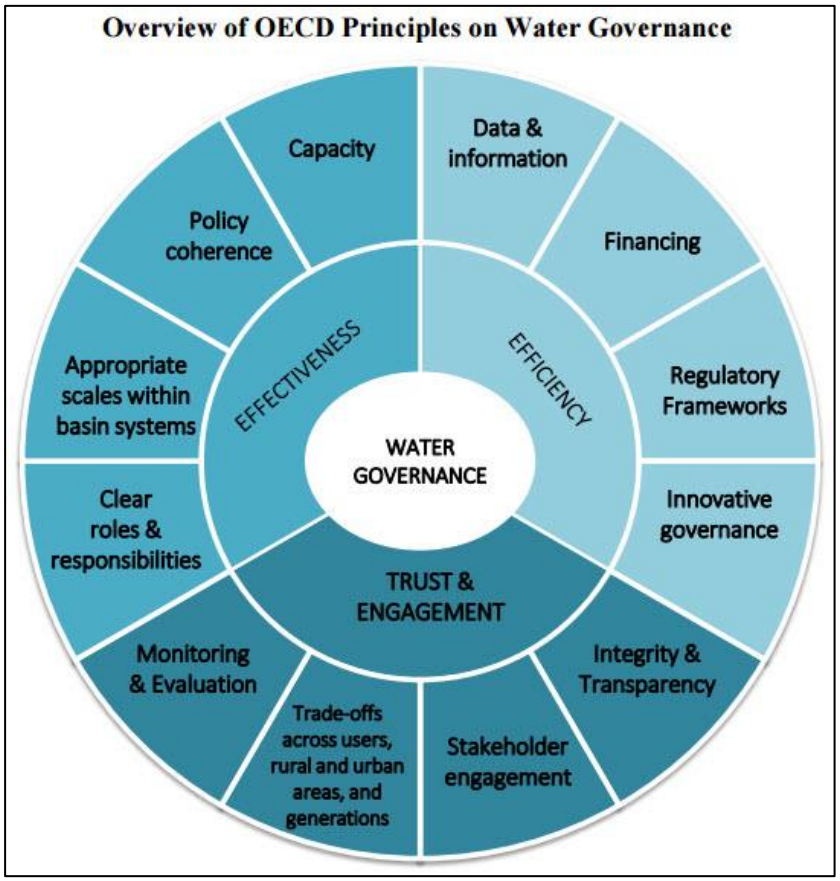

Figure 8: The Principles of the WGF

Source: OECD (d), 2015.

Each one of the following principles was quantified and measured. Indicators were used to perform the analysis on all principles to identify water policy gaps across the seven water projects in Guatemala.

Dimension one: **Effectiveness**

- **Principle 1**: ‘‘*Clearly allocate and distinguish* ***roles and responsibilities*** *for water policymaking, policy implementation, operational management and regulation, and foster coordination across these responsible authorities.*’’

- **Principle 2**: ‘‘*Manage water at the **appropriate scale(s)** within integrated basin governance systems to reflect local conditions, and foster co-ordination between the different scales.*’’
- **Principle 3**: ‘‘*Encourage policy coherence through effective **cross-sectorial co-ordination**, especially between policies for water and the environment, health, energy, agriculture, industry, spatial planning and land use.*’’
- **Principle 4:** ‘‘*Adapt the level of **capacity** of responsible authorities to the complexity of water challenges to be met, and to the set of competencies required to carry out their duties.*’’

Dimension two: **Efficiency**

- **Principle 5:** ‘‘*Produce, update, and share timely, consistent, comparable and policy-relevant water and water-related **data and information**, and use it to guide, assess and improve water policy.*’’
- **Principle 6:** ‘‘*Ensure that governance arrangements help mobilize water finance and allocate **financial resources** in an efficient, transparent and timely manner.*’’
- **Principle 7:** ‘‘*Ensure that sound water management **regulatory frameworks** are effectively implemented and enforced in pursuit of the public interest.*’’
- **Principle 8:** ‘‘*Promote the adoption and implementation of **innovative water governance practices** across responsible authorities, levels of government and relevant stakeholders.*’’

Dimension three: **Trust and Engagement**

- **Principle 9:** ‘‘*Mainstream **integrity and transparency practices** across water policies, water institutions and water governance frameworks for greater accountability and trust in decision-making*’’.
- **Principle 10:** ‘‘***Promote stakeholder engagement** for informed and outcome-oriented contributions to water policy design and implementation.*’’
- **Principle 11:** ‘‘*Encourage water governance frameworks that help manage **trade-offs** across water users, rural and urban areas, and generations.*’’
- **Principle 12:** ‘‘*Promote regular **monitoring and evaluation** of water policy and governance where appropriate, share the results with the public and make adjustments when needed.*’’

6.0 Case Study

6.1 Background

Generally, new potable water systems designed and built in the northwestern highlands of Guatemala, particularly in the Ixil Triangle, are constructions containing natural spring water and often are completed in collaboration between three groups: the village, ACCMARI, and an outside group such as EWB@UWM,. Some villages enhance their well water sources to meet their water demand. In the example of San Pedro Secal, wells exist in the area and are often over-used and heavily contaminated by the time the village is purchasing a spring and getting prepared for a water project.

Due to the political history, mainly manifested by the Guatemalan civil war, Mayan communities in the Ixil Triangle have been marginalized for decades. This has led to villages receiving minimal governmental services including water, education, energy, etc. One of the most urgent needs of the communities is water. In fact, a method used during the civil war to make families flee from their homes, was to destroy any existing water distribution systems. Due to this, there are an enormous number of communities in the Ixil Triangle that do not have water distribution networks that transport water from natural springs to the household. Hence, one of the daily duties of women in these communities is to spend hours carrying water three times daily to satisfy the household needs involving drinking, cooking, and cleaning.

In the past decade and more, some international efforts have targeted communities of the Ixil Triangle aiming to provide sustainable water services. Agua Para la Salud (APS) is a Guatemalan NPO that had been active in designing and building community development projects since 1996 in the Ixil Triangle in the Department of Quiche, among other locations within Gua-

temala. In 2009, Lynn Roberts, the founder of APS, was aiming to find a good replacement that would be capable of filling his position for future years (Jablonski and Reisel, 2012). Mr. Ramirez, the head mason and a local leader, wanted to take over and continue the work of APS. However, Mr. Ramirez communicated a deeper desire to initiate a Guatemalan run and led NPO that works with communities to meet their needs (water systems, schools, bridges, latrines, septic tanks, hand-washing stations, and stoves with chimneys). After consultation and extensive discussions with the communities that worked with Mr. Ramirez, he initiated ACCMARI. ACCMARI works as a channel to connect external groups with local communities. Mr. Ramirez's vast experience with outside groups allows him to understand their abilities and what they are capable of bringing. His childhood in Ixil villages of Guatemala enables him to understand the needs of the area. He bridges the gap of communication between the two worlds and builds capacity within each growing their understanding of themselves as well as how they will and should interact with each other. The communities are empowered to ask for what they really need, and the outside groups truly understand what and how they can meet the villages' needs.

At first, the board of ACCMARI elected a president who did not commit to the goals of the organization. Therefore, shortly after, Mr. Ramirez was elected as a lifetime president of ACCMARI since he had already gained the trust of the board and the communities and is so well versed in this development work. Apart from president, the board of ACCMARI consists of a vice president, a treasurer, and a secretary. The main role of Mr. Ramirez continues to focus on project supervision. When ACCMARI connects an outside group with a village to collaborate on a project, masons are hired to execute the plans (designed by the outside group), and build the systems with the assistance of the community. Regarding ACCMARI meetings, the board members meet at least once every two or three months. Additionally, there is an assembly meeting of

member villages' leaders every six months where the all community representatives gather in order to discuss, prioritize, and coordinate future projects as well as assess previous works and provide feedback.

The main goal of ACCMARI is to complete water projects in the 54+ member communities that it has committed to serve. Mr. Ramirez describes the vision of ACCMARI as ending the suffering among people in Guatemala by meeting their water needs along with other development works. The goal and vision of ACCMARI can be reached by what Mr. Ramirez states as a mission to utilize all available tangible and nontangible resources to best benefit the community that is being served.

6.2 History of ACCMARI

Throughout Mr. Ramirez's work at APS, he met many people from different communities. As mentioned above, ACCMARI has committed to serve 54+ communities. Since there are currently a few outside groups working with ACCMARI to design and construct water projects, ACCMARI assembly meetings focus on prioritizing these particular needs. Decisions about these water projects are based on extensive studies, interviews, and meetings that ACCMARI conducts with the villages. In addition, site visits and inspections occur periodically to evaluate a community and its needs. Another important role for assembly meetings, and gathering the heads of water committees from the 54+ communities, is to offer room for cooperation and collaboration which can result in reducing competition for projects. According to Mr. Ramirez, respective leaders gain full understanding of the needs of the area and make agreements with each other of whose projects will be proposed this year, and whose is coming next year. This lowers hostility between villages and cuts violence and destruction of projects in the area.

A cornerstone of ACCMARI's framework is building capacity within the targeted community. At first, ACCMARI educates the inhabitants about the future water project regarding the different parts of the system. For instance, Mr. Ramirez meets with the community and explains what a distribution tank, spring box, break pressure tank, and chlorinator are, their role in bringing potable water to each household, and the impact that the installation may have on the community's culture and health. Further, ACCMARI ensures that the community understands the water cycle and water conservation principles through a public presentation where women's attendance is required. That way, the users can fully comprehend the functionality of their system as well as prepare for maintaining it. Another key of this framework is creating and supporting a sense of project ownership. In project preparation, the community and therefore the project's users, pay 10% of the materials cost of the project to ACCMARI. These funds are budgeted towards the sustainability of ACCMARI's various operational costs (workshop rent, lighting, salary of the accountant, etc.). The rationale here is to involve the community in funding its own project since the community is the solid base of the project while also supporting the organization that assists in its implementation, operation, and maintenance. The community understands that they need to invest in their project, the outside group needs to see the community's commitment to the project but can afford to fundraise for most of the project, and ACCMARI needs the income in order to self-sustain so that they may assist in maintenance. The community payment will have a large impact on the users who at the time of construction may not fully comprehend the extent of their future needs. Their investment in ACCMARI creates a safety net to assist in the maintenance of the system that they have so heavily invested in. It is worth mentioning here that Mr. Ramirez does not get a salary from ACCMARI because Guatemalan law prohibits board

members of formal associations to be paid for their leadership roles, however, Mr. Ramirez's income can be budgeted into project costs.

Before and during the installation phase, ACCMARI plays a major role in making the dream of delivering water to impoverished communities a reality. For years, ACCMARI has worked only with EWB@UWM. Without ACCMARI, external groups, including EWB@UWM, would not be welcome into Mayan communities due to a fear and mistrust towards foreigners. This attitude originates from Colonial days when Spaniards conquered Guatemala and exploited its resources. Fear continued to grow until after the recent civil war ended in 1996. Through the trust that Mr. Ramirez has gained over many years, EWB@UWM has been well accepted and recognized by Mayan communities. The trust EWB@UWM has gained throughout the years allowed the group to understand the community better and communicate more openly. For instance, two members of EWB@UWM conducted an assessment study that investigated the impact of the water system on the community, with an emphasis on women and children. Women opened their homes and hearts and shared their thoughts and views regarding the survey questions. It is certain that individual attitudes will vary by community, however, considering the area's recent past, this sort of open communication and trust is remarkable/noteworthy.

Capacity building within a community can be responsible for a water system's functionality or collapse. The role of ACCMARI does not end after the project is complete. Mr. Ramirez is accessible to the area and therefore makes maintenance of the system easier. Technical issues can be solved via a phone call or a short visit where Mr. Ramirez instructs user(s) how to handle the problem. Some of the maintenance costs are covered by a previously agreed upon annual fee paid by each family, usually ranging between 10-15 Quetzales per family per year.

6.2 History of EWB@UWM

EWB@UWM started in 2006. Dr. Marissa Jablonski, one of the group's cofounders, was starting her Master's Degree in Civil and Environmental Engineering at UWM at that time. One of the first decisions the group made was to do work in Guatemala. This was chosen because the three other Milwaukee-based EWB groups were working in Guatemala; the idea was that the different Milwaukee EWB groups could help each other on large overlapping projects in Guatemala. For example, EWB@UWM could carry supplies for another group, or if a project team had to go home, a different EWB team could resume the work. The other Milwaukee EWB chapters had connected EWB@UWM with APS and in 2007, the first trip was made to Guatemala to find projects.

In 2007, seven gravity-fed water projects were investigated. During the following two years, work focused on installing the first water system in a community called Quejchip. The installation was completed in the year 2009. In 2010, another water system was installed in La Libertad followed by a joint project in Vijolom III and Vitostix in 2011 and 2012. During 2013 and 2014, the community of Visiban received a pump-fed water system. The pump was required due to the fact that Visiban could not find a spring above their village but found a viable option below. In 2015, San Miguelito received water services. Finally, in January 2016, a water system was installed in the community San Pedro Secal. San Pedro Secal was the first community in the Cotzal municipality; all other projects were built in the Nebaj municipality. For the future, EWB@UWM aims to install more than one water system a year. However, the limited funding of the group continues to be a major challenge towards achieving this goal.

EWB@UWM transitioned their in-country coordinator from APS to ACCMARI. Before ACCMARI became a registered organization, Mr. Ramirez consulted with Dr. Jablonski about

establishing a partnership between the group and ACCMARI. APS understood the need and importance of ACCMARI's inception and offered its contacts and resources to ACCMARI. From there, EWB@UWM and ACCMARI developed a polycentric governance system. Essentially, EWB@UWM, ACCMARI, and each respective community they work with, play an equal, yet different role in the development of a rural water system built in Guatemala. This requires effective communication channels to be in place that are based on trust, cooperation, and understanding of the needs of each party so that the outcome of the project can be collaborative and satisfy the goals.

Dr. Jablonski is working closely with ACCMARI to empower villages to solicit project funds from their respective municipalities. The government could donate construction materials, cover transportation expenses for the group, or deliver materials to construction sites. This may allow for the funding from EWB@UWM to go further in the future. The second goal EWB@UWM is trying to achieve is to continue engineering student involvement outside the period of project installation and also post-graduation. Finally, Mr. Ramirez and Dr. Jablonski have been reaching out to various external groups, mainly from the US, to connect them with ACCMARI. This would accelerate delivering water services to the communities in need in the region as well as it would lessen the dependency on EWB@UWM.

6.4 Discussion

ACCMARI's main challenge is with the low number of projects taking place every year. Currently, ACCMARI can only consistently depend on the implementation of one project a year, and that is with EWB@UWM. The main reason behind this is because of the limited connections ACCMARI has to outside groups and also partly due to the limited funding available to outside groups to construct water projects in Guatemala. Another challenge that goes alongside this issue is that the masons who are familiar with the designs used by ACCMARI projects are not given a stable year-long work due to the infrequency of ACCMARI projects. Therefore, there are times that the masons are asked to suspend their private work to construct an ACCMARI water project since they are familiar with the design. This creates a difficult situation for ACCMARI.

Funds from municipalities could ease the previously mentioned difficulty. According to Mr. Ramirez, more municipal funding should go towards water systems, building schools, hand washing stations, and other facilities that can improve people's lives. On a local level, it was indicated in the interview that the Guatemalan government has promised to financially support projects in the villages that make up ACCMARI, but these promises are rarely fulfilled. This refers to the way that the government generally marginalizes the local Mayan population, as well as not fully understanding their needs. Another challenge for ACCMARI is with communities located in close proximity to cities like Nebaj or Cotzal where it is the expectation that the government will provide them with services, but again rarely fulfill. Deep historic political concerns including corruption often stand in the way of overcoming funding limitations. For this and other reasons, ACCMARI works closely with Dr. Jablonski to establish new partnerships with other external groups that in turn may offer the Guatemalan communities more water projects.

The main contribution of EWB@UWM is fundraising and design. Every year upon the completion of installing a water system, EWB@UWM focuses its efforts on raising funds for the following year's project. In regards to design, EWB@UWM plays an important role in the structural and hydraulic analyses of each component of the water system. For the students, this offers a great opportunity to gain a real life experience designing water systems as well as execute drawings into reality in the field. It is the experience of the group that this approach has led graduates to be global engineers. Recent graduates bring their newly acquired international perspectives to solve local problems. Moreover, the design and analysis conducted by EWB@UWM reviews the preliminary designs proposed by ACCMARI that are based on field experience (as compared to the students' book learning). This cycle of communication assists EWB@UWM to understand the thorough knowledge of ACCMARI as it also solidifies the growing engineering knowledge that EWB@UWM is gaining. Feedback is an essential element in reaching an optimal design that best benefits the community and ensures that they will utilize the water system. As Amadei (2015) discusses, satisficing solutions that bring together opinions and objectives of all stakeholders is much more sustainable in development projects than implementing best design options. EWB@UWM has experience with this in the field. An example from 2008 when EWB@UWM had arrived with a completed design to the village of Quejchip, Guatemala. Upon arrival to the community, EWB@UWM presented the design to find out that the village had changed their mind of what they want from their water system. They had a year to consider what the water system meant to them, how it would change their lives, and how they could manipulate it to fit their needs. It was difficult for the students to understand the importance of adjusting to their opinions because they had spent a multitude of hours completing and checking the design. It was clear that the village valued oral discussions about village decisions and was culturally

requiring that all stakeholders discuss concerns and ideas to reach an agreement. Considering that the success of the project would be measured by whether the water system was being used, owned, maintained, and operated by the village, the opinions of all groups were heard with special attention to those of the village. Some students saw this experience as a failure having to change the design in the field and having not asked enough questions during assessment, however, using current measures of success, the village, ACCMARI, and EWB@UWM consider the project a success. As can be seen by this example, development work requires resilience and flexibility of all parties since plans always change in the field.

7.0 Methodology

7.1 Site visits

In January of 2016, the Student Chapter of Engineers Without Borders at the University of Wisconsin-Milwaukee (EWB@UWM) traveled to San Pedro Secal, Guatemala. With the help of the local partner organization (ACCMARI) and the community, EWB@UWM helped build a gravity-fed water system and chlorination tank that will provide potable water to each household within the community. During the installation, Mr. Ramirez organized the project and supervised the masons who were either building the distribution tank or laying the pipeline.

The seven water projects are chosen to be analyzed as they share some similarities among the communities. First, all communities are male dominant and the role of women is mainly limited to taking care of the household. The leadership of all communities consists of men who take decision regarding the community affairs. Second of all, the communities share almost the same size in terms of population. Most communities have between 30 and 50 households. Lastly, all communities are off-grid marginalized Mayan communities that do not receive any services from

national or municipal government. Therefore, these characteristics of the communities allowed to have them analyzed in this study.

7.2 Interviews

The goal of this study is to identify water policy gaps, if in existence, in the completed water projects that EWB@UWM helped design and construct in Guatemala. The OECD WGF is applied to serve the purpose of this study. To carry out this research, a set of questions was developed to investigate and explore the role of ACCMARI in the sustainable engineering process (Appendix A). A meeting was set up with Mr. Ramirez, who speaks Spanish, and a language interpreter. It is worth mentioning that the interpreter has traveled with EWB@UWM to Guatemala several times and is conscientious of culturally sensitive communication and also has a profound understanding of these collaborative projects. The two-hour interview with Mr. Ramirez started off with questions about the establishment and the history of ACCMARI. Further questions targeted the communities in regards to their governance structure, committees, and the role of women, education, available services, and level of income. Later on, some questions scrutinized the challenges ACCMARI is facing and their hopes for the future.

Another interview was conducted with Dr. Jablonski, co-founder of EWB@UWM, and one of two mentors on the trip (Appendix B). This interview was shorter and conducted in English. The questions towards her examined the history of EWB@UWM, its vision, the relationship between ACCMARI and the local communities, funding issues, and possible partnerships that can help ACCMARI in future projects. All questions in the two interviews were open questions which allowed the interviewee to cover many aspects of the issues discussed. Realizing that Mayan culture heavily values oral communication, this effort was embarked upon with patience in

search for honesty and some historic recollections. Questions were fluid and many answers triggered follow-up which elucidated understanding better.

Due to time constraint, it was quite difficult to interview people from the communities to answer the questionnaire used to assess WGF gaps. Moreover, since the Mayan communities have suffered significantly from a civil war that ended in 1996, there is a lack of trust between local residents and external groups. However, insights from meeting people during site visits have been incorporated indirectly in this project in order to understand the results of this analysis. These insights are articulated in the Discussion chapter to help understand why some principles are poorly or strongly applied in a community.

7.3 Variables identification

As mentioned above, the WGF is based on 12 principles. In this research, the principles are measured in order to address the WGF gaps present in the investigated water systems in Guatemala. Each principle is quantified with a score from 0-10. The value 0 means 'no, the variable is not in agreement with the village's situation, the principle in question is not available or is not applied in a very poor manner', whereas the value 10 means 'yes, the variable is in agreement with the village's situation, the principle in question is available or applied in a very strong manner'. Table 3 shows all scores and what each number indicates:

Table 3: Scores ratings

Value	Indicator
0	Worst
1	Very poor
2	Poor
3	Significantly below average
4	Below average
5	Average
6	Above average

7	Significantly above average
8	Good
9	Very good
10	Best

The value '5' is used as a threshold in this analysis to identify WGF gaps. A principle is considered satisfied if it received an average score above '5' and unsatisfied if it received an average score below '5'. The value '5' is chosen as a threshold because it represents the average application of a principle on the ground. Second of all, some WGF gaps appeared in projects that received average scores below '5' in some principles during site visits. Finally, this threshold is used to identify gaps across all principles. The reason for that is because each principle has been analyzed as an independent variable. Hence, the value '5' is used in all principles instead of determining different values for different principles in order to eliminate correlation among the principles.

7.3.1 Eliminated Variables

One of the challenges for this analytical approach of applying the WGF is that not all principles apply to the case study. Therefore, the principles of 'Appropriate Scale', 'Capacity', 'Innovative Water Governance', and 'Trade-Offs' have been eliminated and not been applied. The main reason for the elimination of these principles refers to the fact that the WGF has been essentially developed to evaluate water governance on national and sub-national levels of state or country government. In this research, however, water projects being analyzed are off-grid and not served by the Guatemalan government. Moreover, some principles diagnose certain aspects of governance that are not necessarily present in the investigated projects. The four eliminated principles are listed below with a brief description for why they are disregarded (OECD (b), 2015):

‘**Appropriate Scale**’ principle

‘‘*Manage water at the **appropriate scale(s)** within integrated basin governance systems to reflect local conditions, and foster co-ordination between the different scales.*’’

This principle explores how water resource management practices should promote for adaptive and mitigation strategies, action programs and measures that are based on coherent mandates through effective basin management plans that are consistent with national policies. Moreover, the principle investigates the relationship among riparian users on the use of transboundary freshwater resources. These cases do not apply on the investigated projects since watershed management plans and freshwater resource riparian agreements are not in place at the level of governance the analyzed projects have.

‘**Capacity**’ principle

‘‘*Adapt the level of **capacity** of responsible authorities to the complexity of water challenges to be met, and to the set of competencies required to carry out their duties.*’’

This principle explores how to promote for hiring public officials and water experts and professionals who are capable of applying merit-based, transparent processes to water management plans. In addition, it explores ability of ‘developing adaptive and evolving assignment of competences upon demonstration of capacity’. On a community local level, this principle does not apply.

‘**Innovative Water Governance**’ principle

‘‘*Promote the adoption and implementation of **innovative water governance practices** across responsible authorities, levels of government and relevant stakeholders.*’’

This principle explores ways to promote for strong interface between policy and science to develop existing water governance and bridge the gaps between scientific

knowledge and practices of water governance. This is mainly the responsibility of municipal and national government, and goes beyond the capacity of the community.

‘**Trade-Offs**’ principle

‘‘*Encourage water governance frameworks that help manage **trade-offs** across water users, rural and urban areas, and generations.*’’

This principle explores ways to empower local authorities in order to address barriers facing good water quality and quantity services as well as promote rural-urban cooperation. It also explores ways to promote public debates to address risks and costs associated with water issues (quality and quantity) in order to raise awareness and discover ways to build consensus to assign responsibility to guarantee affordable, sustainable water governance.

7.3.2 Performed Variables

The other eight principles are quantified by investigating each one of them individually through a set of questions (Appendix C). Each principle is investigated through a few questions to help measure the principle across the seven projects. For instance, for principle one, five questions are developed and applied across all projects. Each project receives a score from 0 to 10 per question for each principle. The scores are obtained from the respondent who evaluates and answers each question based on their knowledge about the water systems. The drawback of this method is that there is no clear definition of what each score exactly means. Hence, there might be a slight difference in scores if a different respondent answered the questions.

7.4 OECD WGF Policy Gaps

The OECD WGF identifies seven water policy gaps. The gaps are: administrative gap, information gap, policy gap, capacity gap, funding gap, objective gap, and accountability gap. All the gaps are defined in section 5.2. This section explains which principle identifies which gap.

The six WGF gaps are assigned to the eight principles that were discussed in section 7.3. Four gaps are assigned to one specific principle whereas the other two gaps, each one of them is assigned to two principles. Table 3 shows the assignments between gaps and principles used in this analysis:

Table 4: Assigning Principles to OECD WGF Gaps

OECD WGF Gap	Principle
Information gap	Data and Information principle
Policy gap	Clear Roles and Responsibilities principle
	Regulatory Framework principle
Capacity gap	Stakeholder Engagement principle
Funding gap	Financing principle
Objective gap	Policy Coherence principle
Accountability gap	Integrity and Transparency principle
	Monitoring and Evaluation principle

The administrative gap has been eliminated from this analysis due to lack of applicability. The administrative gap explores the mismatch between administrative and hydrological boundaries and this can be the origin of resource and supply gaps (OECD, 2011). The administrative gap does not apply on the case study since the water system were installed within a small area of the northwestern highlands of Guatemala. The whole area is not crossing any hydrological or administrative boundaries. Thus, the administrative gap does not appear to contribute to the analysis of defining water policy gaps across the seven water projects being investigated.

8.0 Analysis

The main outcome of this research is to identify water policy gaps in seven water projects completed by ACCMARI, a village, and EWB@UWM in Guatemala. For that purpose, the OECD WGF is applied to diagnose each project individually and address if any of the following gaps is present; policy gap, administrative gap, objective gap, capacity gap, funding gap, information gap, or accountability gap. As mentioned in section 5.3, the WGF is based on several principles. In this research, principles are used to identify the water policy gaps that the WGF addresses. For that purpose, principles are used as independent variables that will eventually be used to diagnose water projects and identify any water policy gaps.

As mentioned in section 7.3.2, eight principles are applied and measured. A questionnaire (Appendix C) is performed and an interview is conducted to analyze each principle. One principle has four questions, two principles have five questions, and five principles have six questions. Each question is applied to each of the seven projects and answered by giving a value from 0 to 10 (explained in section 7.3). For each water project, a total score is recorded by summing up all scores for all answers for each particular principle.

Since not all principles have the exact number of questions, an average score is calculated for each project per principle. This is done to identify the strongest and weakest water projects in regards to a certain principle. Likewise, an average of averages is calculated for all projects per principle. This number represents the manifestation of each principle compared to the others.

In the analysis for each project, a gap is identified when the average score of a principle is below the value of 5. When an average score of a principle is below 5, the water policy gaps which the principle is assigned to will be highlighted. This criterion is used to answer the first

research question regarding how the OECD Water Governance Framework identifies water policy gaps.

9.0 Results

This chapter illustrates the main findings of the analysis. Findings are divided into two categories: principle-based findings and project-based findings. A brief description is provided for each graph and results are further discussed in the Discussion Chapter.

9.1 Principle-based findings

Principle-based findings are the results of the analysis that show average scores of a certain principle across all projects. In this section, eight graphs are presented that show the performance of each project regarding a certain principle.

Figure 9 shows the average scores of Clear Responsibilities and Roles principle 'P1' across the seven water projects. This graph shows that P1 is not satisfied for all the projects. Projects of La Libertad, Visiban, and San Pedro Secal have shown strong application of this principle since the average scores of P1 for these three projects are more than 5.

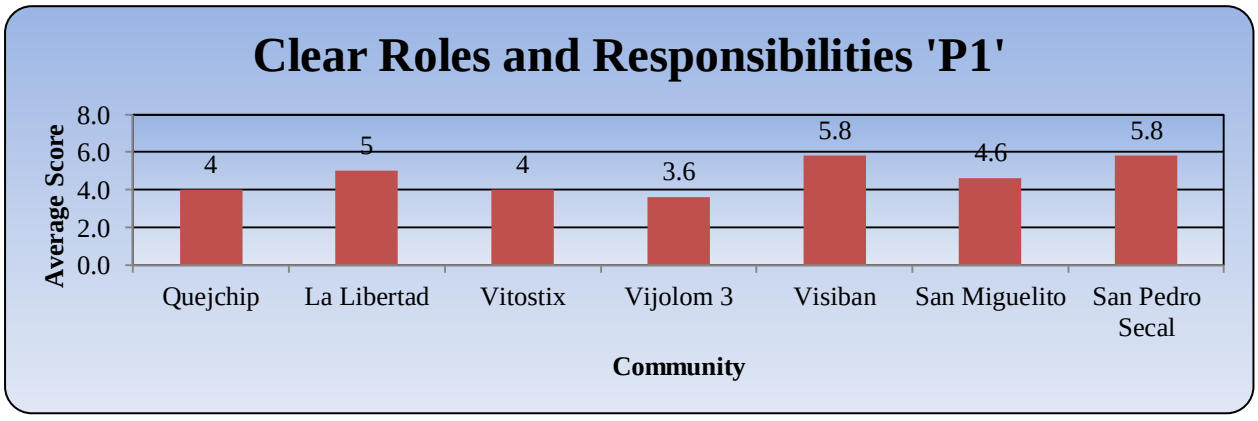

Figure 9: Clear Roles and Responsibilities 'P'

Figure 10 shows the average scores of Policy Coherence principle ‘P3’ across the seven water projects. This graph shows that P3 is satisfied in five out of seven projects. Projects of La Libertad and Vitostix have shown weak application of this principle since the average scores of P3 for these two projects are less than 5.

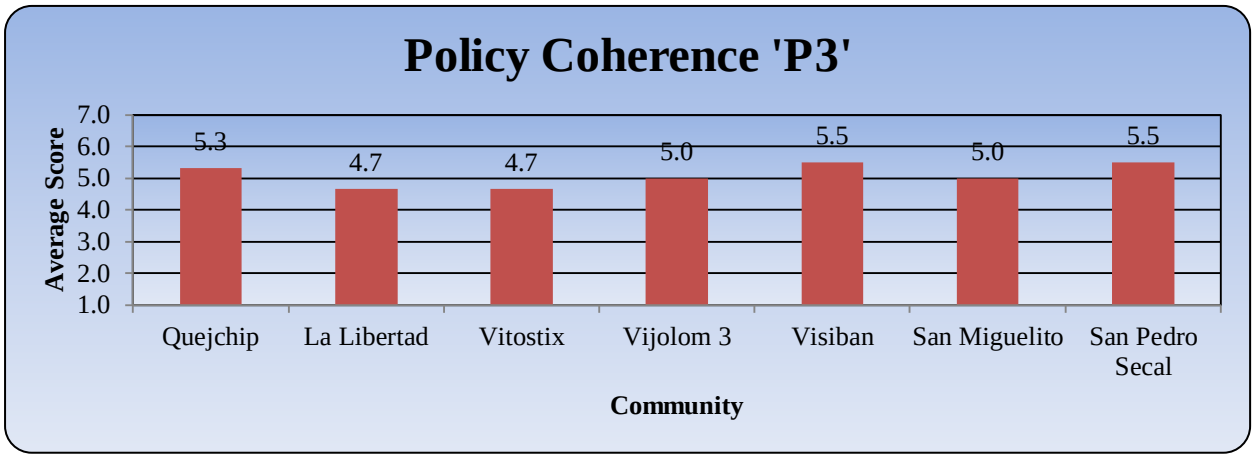

Figure 10: Policy Coherence 'P3'

Figure 11 shows the average scores of Data and Information principle ‘P5’ across the seven water projects. This graph shows that P5 is not satisfied for almost any of the projects. Only the project of Visiban has shown strong application of this principle since the average score of P5 for Visiban is more than 5.

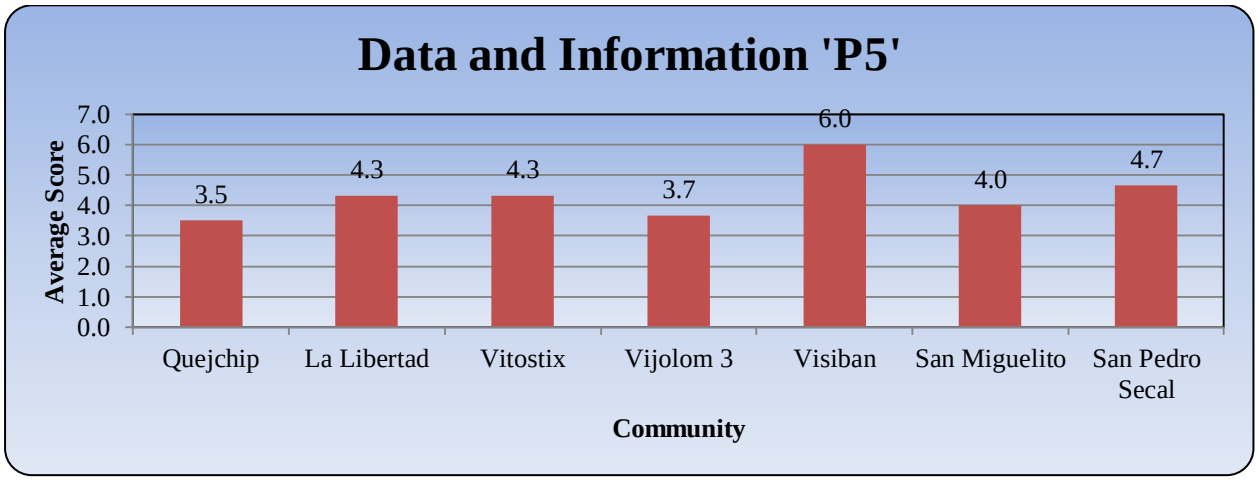

Figure 11: Data and Information 'P5'

Figure 12 shows the average scores of Financing Principle ‘P6’ across the seven water projects. This graph shows that P6 is satisfied for all the projects. All projects have shown strong application of this principle since the average scores of P6 for all projects are more than 5.

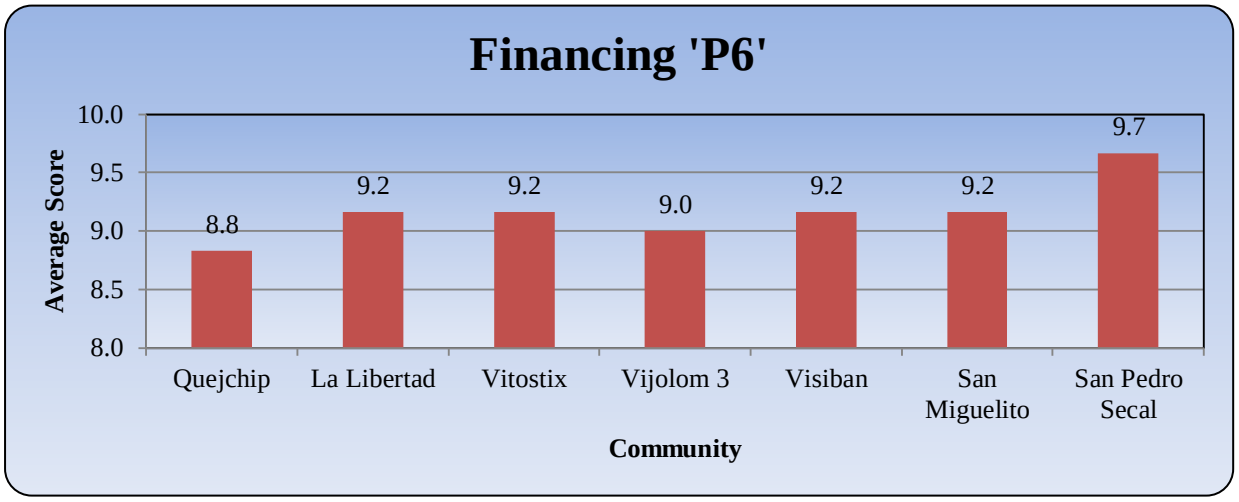

Figure 12: Financing 'P6'

Figure 13 shows the average scores of Regulatory Frameworks principle ‘P7’ across the seven water projects. This graph shows that P7 is satisfied for all the projects. All projects have shown strong application of this principle since the average scores of P7 for all projects are more than 5.

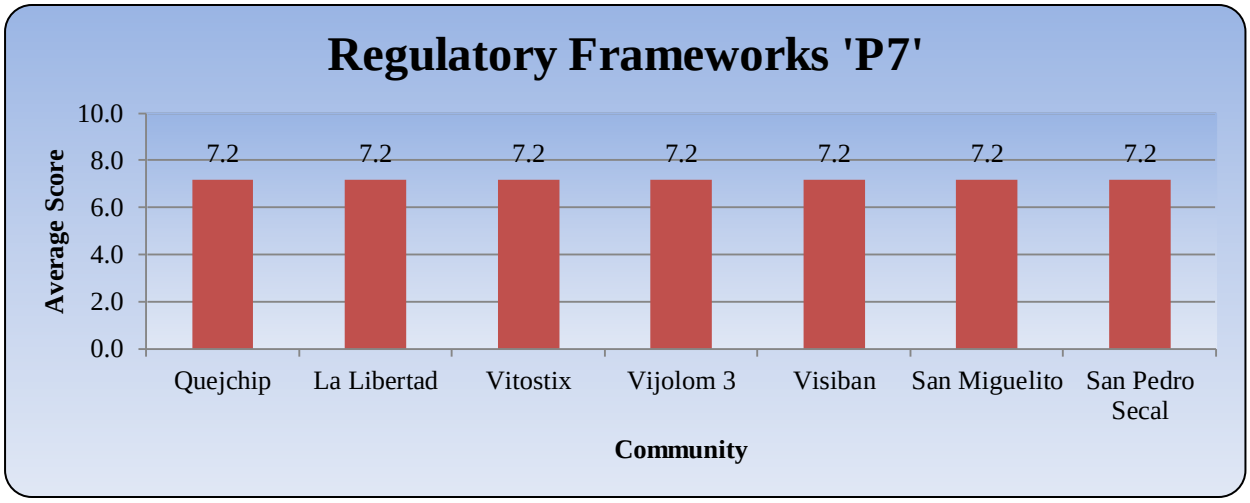

Figure 13: Regulatory Framework 'P7'

Figure 14 shows the average scores of Integrity and Transparency Practices Principle ‘P9’ across the seven water projects. This graph shows that P9 is satisfied for all the projects. All projects have shown strong application of this principle since the average scores of P9 for all projects are more than 5.

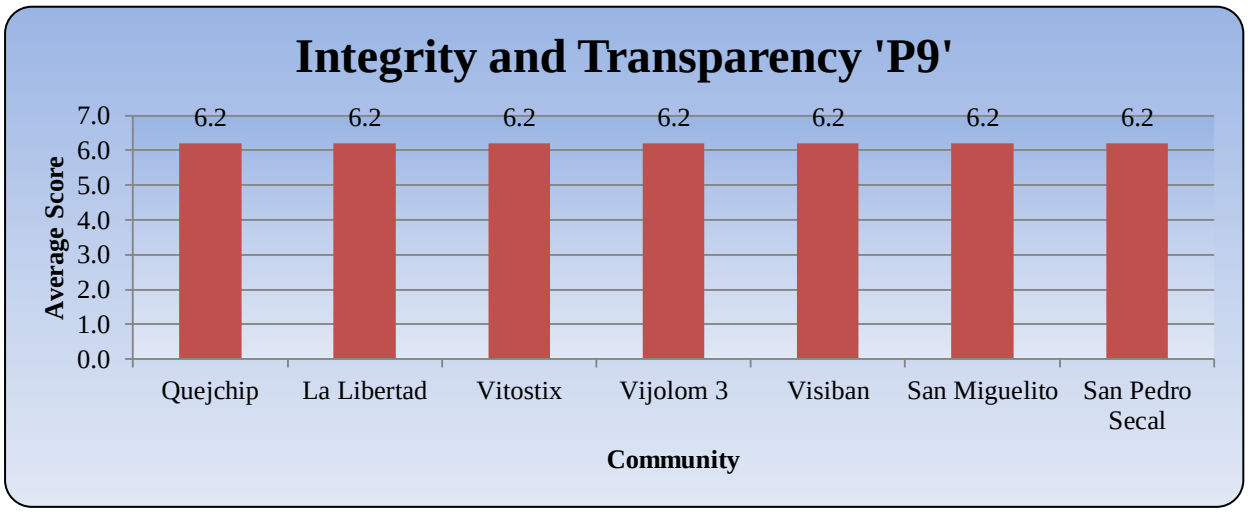

Figure 14: Integrity and Transparency 'P9'

Figure 15 shows the average scores of Promote Stakeholder Engagement Principle 'P10' across the seven water projects. This graph shows that P10 is satisfied for all the projects. All projects have shown strong application of this principle since the average scores of P10 for all projects are more than 5.

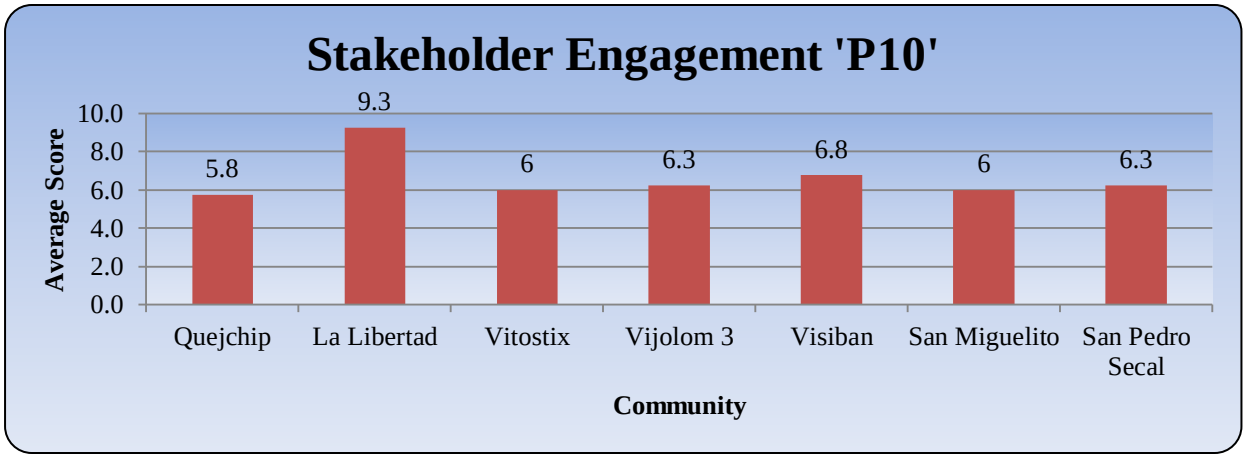

Figure 15: Stakeholder Engagement

Figure 15 shows the average scores of Monitoring and Evaluation principle 'P12' across the seven water projects. This graph shows that P12 is satisfied for all the projects. All projects have shown strong application of this principle since the average scores of P12 for all projects are more than 5.

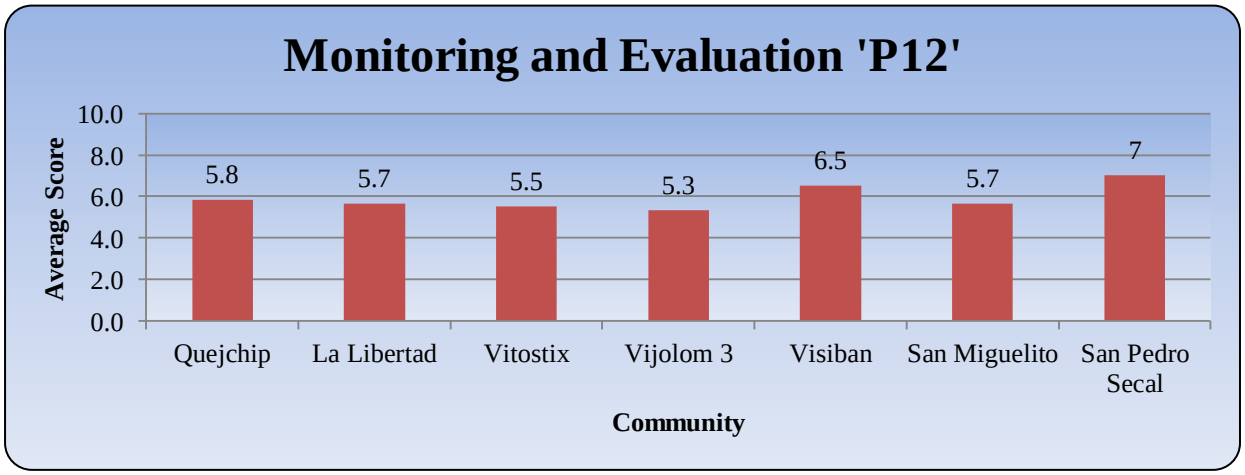

Figure 16: Monitoring and Evaluation 'P12'

9.2 Project-based findings

Project based findings are the results of the analysis that show average scores of a certain project across all principles. In this section, seven graphs are presented that show how each project performs regarding all principles.

Figure 17 shows the average scores of all principles regarding Quejchip water project. This graph shows that Quejchip is satisfying six out of eight principles. In the Quejchip project, the Roles and Responsibilities principle and the Data and Information principle have shown weak implementation since the average scores of P1 and P5 are less than 5.

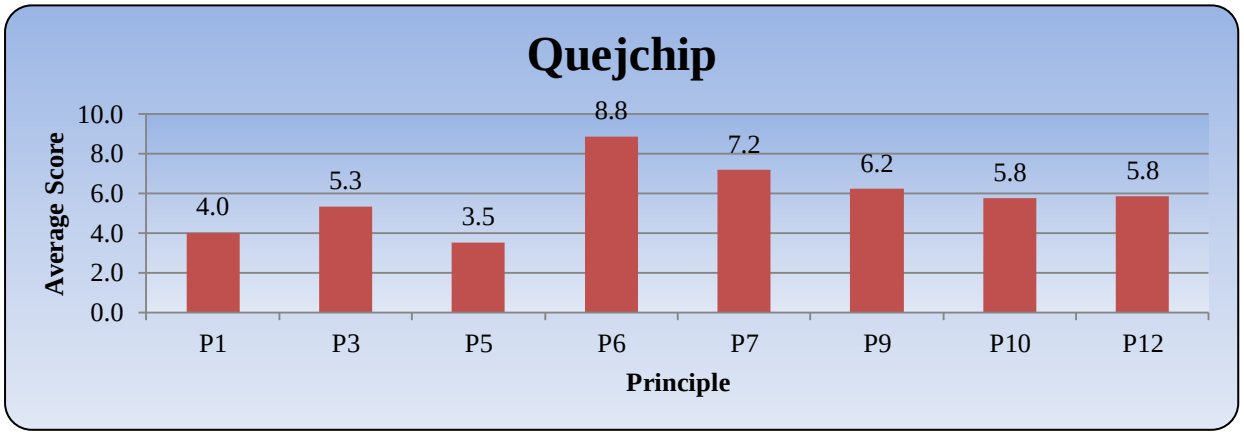

Figure 17: Quejchip

Figure 18 shows the average scores of all principles regarding La Libertad water project. This graph shows that La Libertad is satisfying six out of eight principles. In La Libertad project, the Cross-sectorial Coordination principle and the Data and Information principle have shown weak implementation since the average scores of P3 and P5 are less than 5.

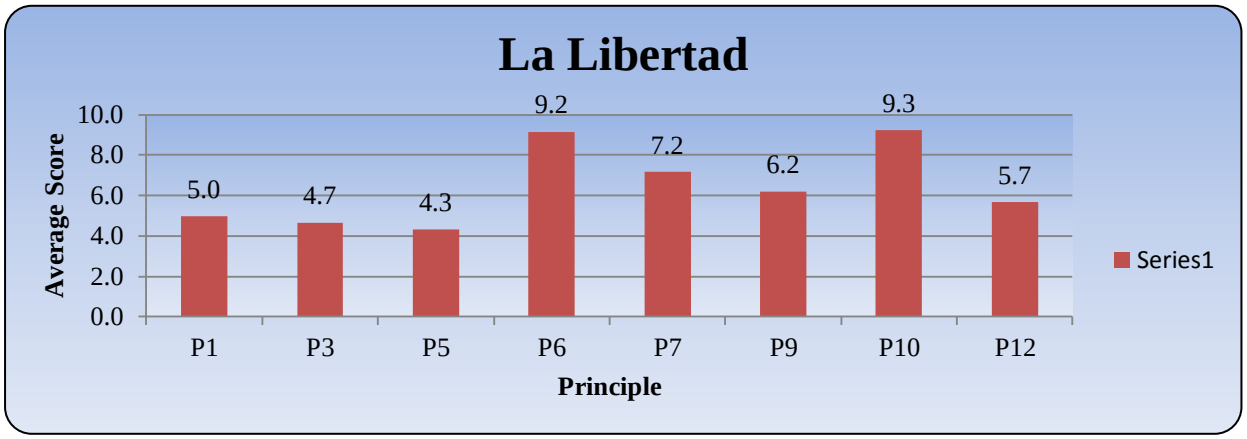

Figure 18: La Libertad

Figure 19 shows the average scores of all principles regarding Vitostix water project. This graph shows that Vitostix is satisfying five out of eight principles. In Vitostix project, the Roles and Responsibilities principle, the Cross-sectorial Coordination principle, and the Data and Information principle have shown weak implementation since the average scores of P1, P3 and P5 are less than 5.

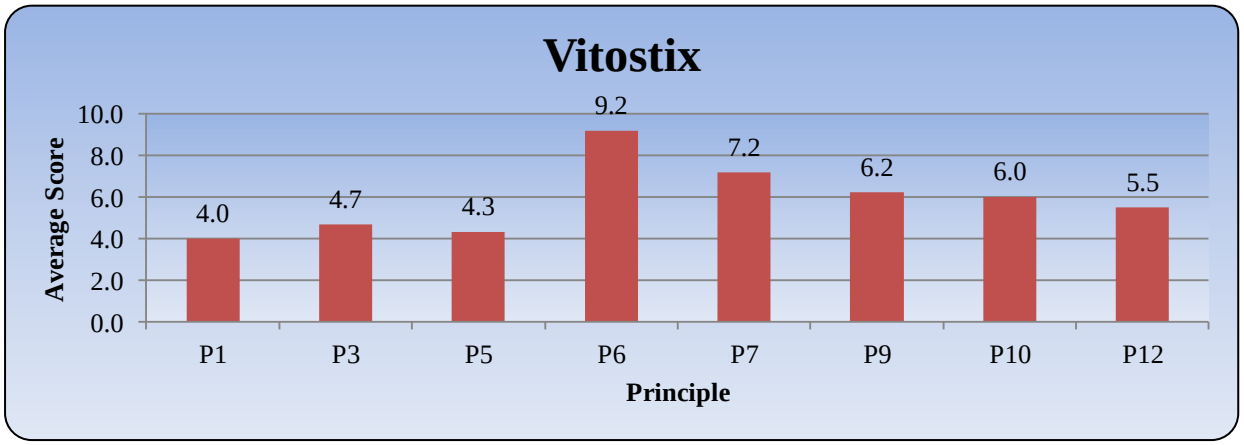

Figure 19: Vitostix

Figure 20 shows the average scores of all principles regarding Vijolom 3 water project. This graph shows that Vijolom 3 is satisfying six out of eight principles. In Vijolom 3 project, the Roles and Responsibilities principle and the Data and Information principle have shown weak implementation since the average scores of P1 and P5 are less than 5.

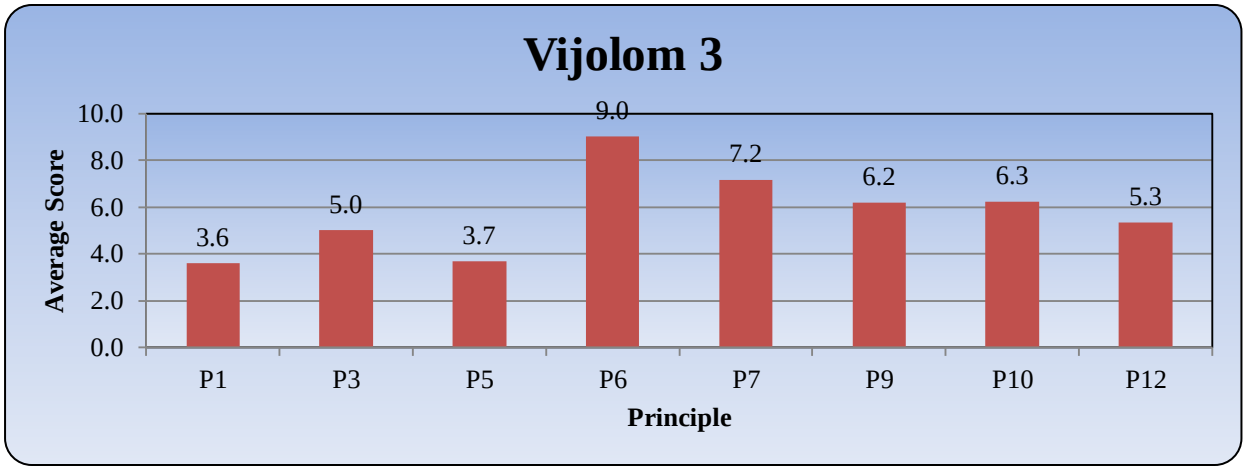

Figure 20: Vijolom 3

Figure 21 shows the average scores of all principles regarding the Visiban water project. This graph shows that Visiban is satisfying eight out of eight principles. In Visiban project, all principles have shown strong implementation since the average scores of them are more than 5.

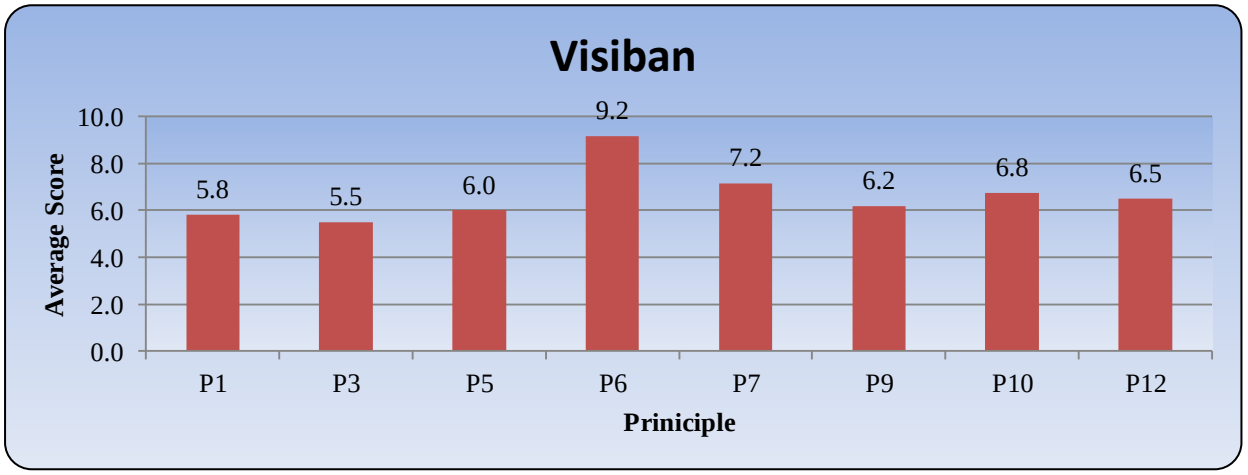

Figure 21: Visiban

Figure 22 shows the average scores of all principles regarding San Miguelito water project. This graph shows that San Miguelito is satisfying six out of eight principles. In San Miguelito project, the Roles and Responsibilities principle and the Data and Information principle have shown weak implementation since the average scores of P1 and P5 are less than 5.

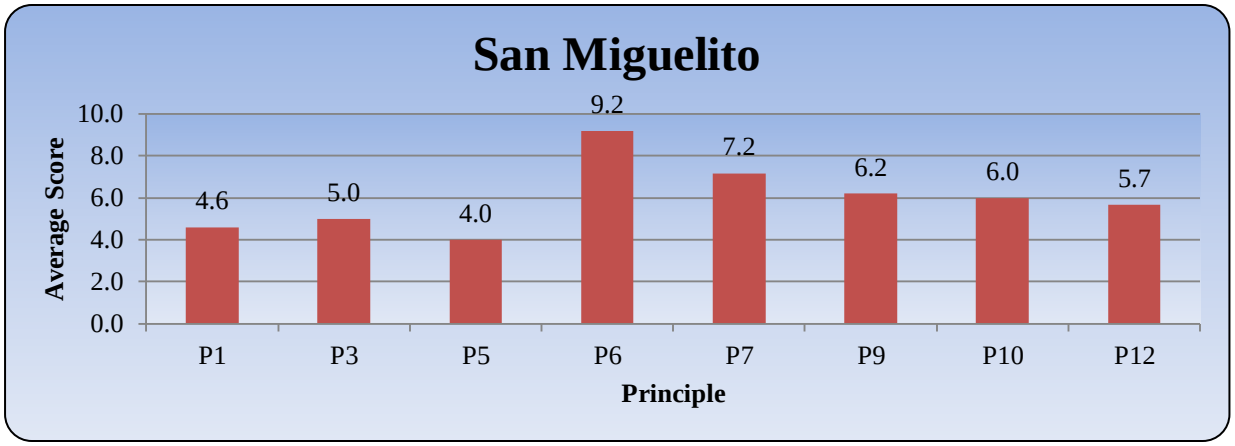

Figure 22: San Miguelito

Figure 23 shows the average scores of all principles regarding the San Pedro Secal water project. This graph shows that San Pedro Secal is satisfying seven out of eight principles. In the San Pedro Secal project, the Data and Information principle has shown weak implementation since the average score of P5 is less than 5.

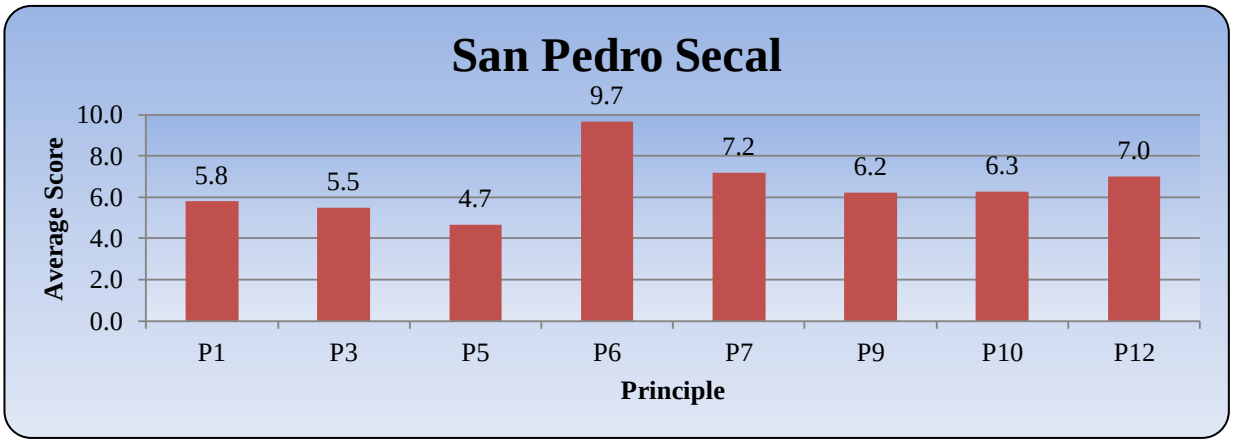

Figure 23: San Pedro Secal

10.0 Discussion

This research aims to identify water policy gaps in water projects completed by EWB@UWM in Guatemala. This analysis used the OECD Water Governance Framework to identify and address water policy gaps in the investigated water projects. Eight variables, known as 'principles', are defined and measured to achieve the purpose of this study. This chapter includes two sections. The first section discusses the results shown in Chapter 9.0 and assesses all principles. The second section addresses any present gaps according to the performed framework.

10.1 Principles Analysis

10.1.1 Clear Roles and Responsibilities 'P1'

The Roles and Responsibilities principle has been satisfied in three projects out of seven projects. The projects of La Libertad, Visiban, and San Pedro Secal have shown effective implementation of this principle. This mainly refers to the role of the water committees in these communities. The water committees played a strong role in project design, implementation and monitoring phases of the project. More specifically, water committees have shown good understanding of their responsibilities and acted upon them in these three communities unlike the rest of the communities.

In other communities, water committees have been in place, however, their actions on the ground did not meet their responsibilities or the expectations of the inhabitants especially regarding maintenance. Another very important factor that contributed to weak application of this principle is the inhabitants of the community themselves. Where this principle is unsatisfied, local residents did not play their role in the project such as infrastructure construction (i.e. trenching,

transporting materials and tools etc.). As a result, internal conflict within the community may appear. For instance, in San Pedro Secal, the community refused to allow a member to receive a water system because he did not participate and help the community while trenching for the water pipeline. Consequently, that household could not receive a water system until conflict is settled.

10.1.2 Policy Coherence 'P3'

The Policy Coherence principle has been satisfied in most of the investigated projects. Only two projects have shown a weak application of this principle. The projects of La Libertad and Vitostix show average scores of 4.7. This principle was explored through investigated five main areas:

1. The presence of a 'New Project' committee and what role it plays.
2. Any plans for future projects in the following sectors: environment, health, energy, agriculture, industry, or spatial planning and land use.
3. Number of times heads of all committees of a community meet.
4. Documentation.
5. Reaching out to municipal and national governments.

Regarding the third, fourth and fifth areas, all scores indicated same value of 10, 5 and 1 respectively for all communities. This is due to the strong role of ACCMARI in terms of ensuring its comprehensive model that encourages policy coherence through effective cross-sectorial coordination within each community. However, a slight difference has been witnessed regarding the first and second areas. This may refer to the autonomy of each community in terms of addressing their needs and planning how to meet them. All communities have had a New Project

committee. However, the role of this committee in the communities of La Libertad and Vitostix was not as strong as other committees appeared to be in other communities. There was a lack of leadership and commitment by these committees towards the water projects and the community itself. Therefore, there needs to be new mechanisms initiated within these two communities to create multidimensional and systematic approaches to improve the performance of the New Project committees.

10.1.3 Data and Information 'P5'

The Data and Information principle has been satisfied in only one project out of seven projects. The only project that effectively applied the Data and Information principle is Visiban. The application of this principle in this community particularly refers to the ability of the community to report problems and emergencies to ACCMARI which allows for coordination and cooperation towards solving the matter. In fact, results have shown that all communities, mainly water committees, report to ACCMARI about spring flow rate fluctuations, household usage allowance, domestic use versus agricultural use, and any system malfunctions.

All communities were rated a score of 4 whereas Visiban was rated 6. Site visit to Visiban water system has shown that the community shares data and information with ACCMARI especially because of their electrical pump. Visiban is the only water system that is not gravity-fed system. Due to topography, a water pump was required to transport water from the water source to the distribution tank before it is delivered to households. The presence of the electrical pump created and strengthened channels of communication between the community and ACCMARI regarding sharing data and information. The main reason behind that is because of the technical problems associated with the water pump.

The appearance of an Information gap is a very serious issue. This gap can hinder an attempt to develop the community in the future. As the community may not be aware of the consequences of the this gap, the Information gap limits the chances for the community to communicate with other communities or external groups since information is not flowing across engaged actors. Thus, planning for future projects would be more difficult as it is not based on reliable systematically generated data and information.

10.1.4 Financing 'P6'

The Financing principle has been satisfied in all projects that were investigated in this study. All projects have shown effective implementation of this principle. This area of success in all projects refers to several reasons. First, all projects have worked directly with the ACCMARI's treasurer in high level of capacity, transparency, and trust. Second of all, all communities have the right to investigate the treasurer who is responsible for the community's finances. Finally, the users of the water system in all communities are involved in determining obligatory fees such as maintenance fee.

The Financing principle investigated whether or not a community has a treasurer to manage the community's finances. Additionally, it explored how a treasurer is elected by the community and the community participatory role in determining fees and charges. All questions were rated 10 except for one particular question which illuminated a difference among the seven projects. The capacity and role of the treasurer as well as working closely with ACCMARI did not appear to be the same across the communities. San Pedro Secal was rated 8 whereas the rest of the communities were rated 5 or below. This made a slight variance across the projects, however, no average score at any community was below 5. In fact, average scores ranged from 8.8 and 9.7 which explains why the Financing principle is well applied throughout all communities.

10.1.5 Regulatory Frameworks 'P7'

The Regulatory Frameworks principle has been satisfied in all projects that were investigated in this study. All projects have shown effective implementation of this principle. Successful application of this principle across all projects refers to several reasons. First, there has been a lot of work invested in community capacity building which has resulted in having communities ask for what they need. This leads to the second reason of having capacity for water committees to enforce what has been agreed upon between the community and ACCMARI.

Results have also shown that the community plays a major role in terms of determining who receives water services from the water system. As a community, everyone is responsible to participate in building the water system. ACCMARI does not interfere with internal affairs within the community. Hence, the community takes the lead regarding how inhabitants should take part in the project and identifying tasks for all individuals.

Scores regarding Regulatory Frameworks principle were all the same. Average scores were 7.2. One of the factors that weakens the application of this principle is the role of water committees. As explained in section 10.1.3, the role of water committees as well as other committees has to be strengthened and empowered by the communities themselves in order to effectively execute plans and projects to meet the needs of people.

Regarding principle average scores that were the same for all communities, this may refer to the strong model of ACCMARI, community, and EWB@UWM. This poly-centric model appears to be consistent with all communities. Thus, no variations were witnessed concerning this principle.

10.1.6 Integrity and Transparency ‘P9’

The Integrity and Transparency principle has been satisfied in all projects that were investigated for this study. All projects have shown effective implementation of this principle. There are two main reasons for this successful application of this principle. First of all, community is entirely involved in the election process to choose the water committee. This has led the community to have the right to investigate the work of the committee, hence, avoid corruption from occurring. The second main reason is about the community involvement in the projects and its contribution to the associated costs. As a result, the community has acquired a sense of ownership of the water system which helps operating and maintaining it.

Similar to the Regulatory Frameworks principle, the Integrity and Transparency principle had the same score results for all projects. This principle received a score of 6.2 across the seven investigated projects. This may refer to the cultural aspect of communities in terms of how they monitor the work of their water committee representatives. Moreover, it is up to the community how they create mechanisms to avoid corruption and how to handle it if it happens.

Site visits to communities have shown that corruption has happened in the past. Corruption was mainly witnessed as some users using water for agricultural purposes instead of domestic purposes. This in turn may reduce the availability of water for the rest of the community. The community is responsible for addressing any corruption that may occur by water committees, or the system users themselves.

10.1.7 Stakeholder Engagement ‘P10’

The Stakeholder Engagement principle has been satisfied in all projects that were investigated for this study. All projects have shown effective implementation of this principle. There

are several reasons for successfully applying this application. First, all communities have attended meetings that take place before, during and after the completion of the project and are organized by ACCMARI. This has allowed for higher level of participation among members of each community. However, it was witnessed that not all members attend the meetings. This explains the variance regarding scores among communities. This was the most significant factor for why the community of San Pedro Secal received highest score regarding this principle due to percentage of people attending and participating in these events. The average score of San Pedro Secal was 9.3 where the rest of the communities had their scores between 5.8 to 6.8.

The other main reason for satisfying this principle is due to creating a space for community members to raise their voice and achieve a consensus among themselves to have a water system that meets their needs. These meetings are very essential to raise and consider the voice of all groups within a community such as women, men, children, and elderly.

10.1.8 Monitoring and Evaluation 'P12'

The Monitoring and Evaluation principle has been satisfied in all projects that were investigated for this study. All projects have shown effective implementation of this principle. This successful application of the Monitoring and Evaluation principle across the projects refers to several reasons. First of all, water committees fulfills their responsibilities, to a certain extent, towards monitoring the water systems. Second of all, the water committees have been reporting technical issues with ACCMARI which has created a space for sharing knowledge and allowed for technical assistance from ACCMARI's expertise and masons especially in Visiban water system. As a result, water systems continued to be operating and well-maintained.

Finally, most water committees have been sharing information regarding their water system with other communities which allowed for communities to be a part of a larger cooperative, collaborative, and communicative organization.

10.2 Gaps Identification

The OECD WGF identifies seven gaps that may appear in water development projects. In this study, the administrative gap was eliminated because it does not apply to the case study. Principles were used to identify WGF gaps. Chapter 9 presents two types of findings; Project-based findings and Principle-based findings. Project-based findings aimed to show which principles are satisfied and which principles are unsatisfied in each community. These findings are used to identify the six WGF gaps. Principle-based findings aimed to show variations across all communities regarding each principle individually. These findings are used to evaluate the poly-centric model which consists of ACCMARI, EWB@UWM and the community.

Figure 24 presents a summary of all communities across the eight principles. This figure illustrates how each principle is applied in every community. Moreover, it shows all communities as a group and how they perform regarding each principle. This indicates which principles are well or poorly applied and that in turn helps identify WGF gaps. Furthermore, this figure describes the performance of the poly-centric model used by EWB@UWM and ACCMARI.

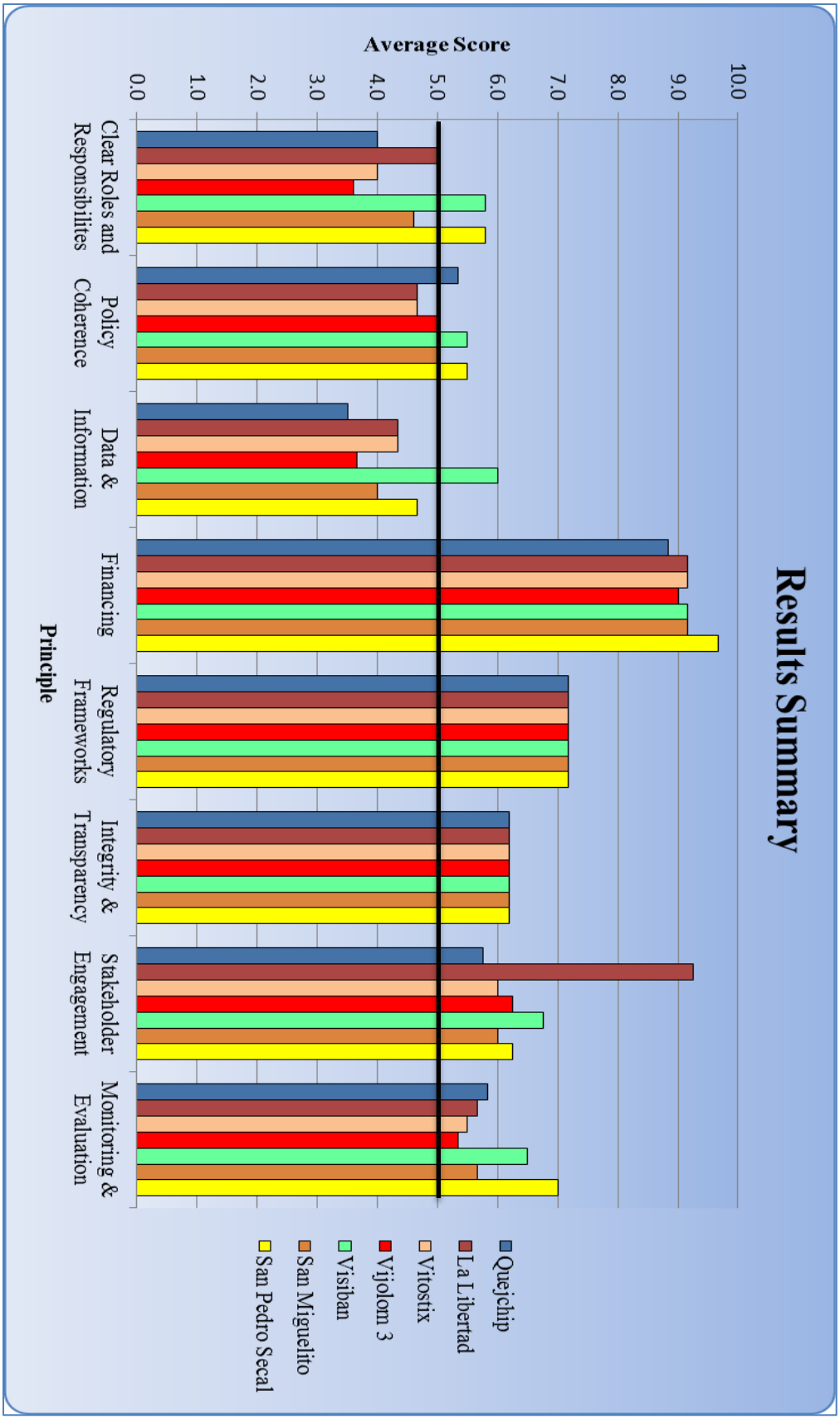

Figure 24: Results summary

The graph above shows that the first three principles (Clear Roles and Responsibilities, Policy Coherence, and Data and Information) have been poorly applied in the seven communities compared to other principles. These three principles determined where WGF gaps exist since some communities had an average score of less than 5. Hence, these principles require further investigation and discussion, particularly between ACCMARI and the communities in order to improve how they can be better applied especially for future projects.

The graph also shows that the Financing principle is very strongly applied across the seven projects. In fact, the average score of all communities regarding this principle is 9.2, which is higher than the average score of any other principle. It is important for ACCMARI and EWB@UWM to maintain this good performance of this principle.

Regulatory Frameworks and Integrity and Transparency principles received average scores of 7.2 and 6.2 respectively. These two principles were the only principles that received same score across all communities. As mentioned in sections 10.1.5 and 10.1.6, this mainly refers to consistency in the model used by ACCMARI and EWB@UWM. The application of these two principles needs to be enhanced in order to improve the outcome of the water projects and avoid any corruption that may happen.

Lastly, Stakeholder Engagement principle and Monitoring and Evaluation principle have both achieved a score above 5. However, results have shown variations among communities regarding how these two principles are applied. The community of La Libertad received a score of 9.3 in Stakeholder Engagement whereas the average score for the rest of the communities is 6.2. The main reason for this outstanding performance of engaging stakeholders is the ability of the

community to raise the voice of all sub-groups in the community. Women take a considerable part in attending meetings and making decision regarding their water system.

Information gap was identified by measuring the Data and Information principle. This gap was identified in all water projects except for Visiban that received an average score of 6. The rest of the communities received a score below 5 which identified that Information gap is present. An Information gap occurs where there is an asymmetry of information across a community committees and, on a larger scale, communities themselves. It is likely for Information gap to appear when water committees, in particular, do not actively share their knowledge. In practice, water committees tend to have more information about local needs and preferences. Unless these needs are communicated and shared, an Information gap is generated. Water committees should generate reliable data on a timely bases and communicate with ACCMARI to bridge this gap. Finally, what a water committee at a certain community shares is partial and limited to that specific community. Thus, ACCMARI plays an indispensable role in organizing and managing the obtained information so as to support the broader vision of ACCMARI.

Policy gap was identified by measuring two principles; Clear Roles and Responsibilities principle and Regulatory Frameworks principle. This gap was identified in the communities of Quejchip, Vitostix, Vijolom 3 and San Miguelito. In this analysis, the Regulatory Frameworks principle was satisfied in all communities, therefore, the Clear Roles and Responsibilities was the principle that determined the occurrence of the Policy gap. Policy gap refers to the sectorial fragmentation among stakeholders related to water activities. Clearly defining tasks for each stakeholder would improve the application of the Clear Roles and Responsibilities principle. More responsibility should be taken by water committees to act on their obligations before, during and after a water system is installed.

Capacity gap was not present in any community. The Stakeholder Engagement principle was measured to identify the Capacity gap. Regarding this principle, all communities received an average score above 5. Although a Capacity gap was not identified in any project, there should be new mechanisms to enhance and empower stakeholder engagement especially within a community. La Libertad is a clear example of how to apply the Stakeholder Engagement principle very efficiently and effectively. It is vitally important to allow for all groups within a community to raise their voice and incorporate these voices into the decision making process. Thus, water development outcome is more like to satisfy most, if not all, needs of the community.

Funding gap was not present in any community as well. The Financing principle was measured to address the Funding gap. As mentioned in section 10.1.4, the Financing principle received highest scores compared to other principle. This refers to the strong application of this principle where budgetary responsibilities are well distributed among stakeholders. Funds are raised by EWB@UWM to cover construction costs of the project and support ACCMARI. ACCMARI receives the funds and supply the construction site with materials and equipment needed for the water system. The community in turn pays a fee to receive a project which helps the system's users gain a sense of ownership of the project. Moreover, users pay maintenance fee to ensure that financial stability in case of malfunction of the water system.

Objective gap was present in two communities. The Policy Coherence principle was measured to identify this gap. Objective gap was identified in La Libertad and Vitostix. Although the rest of the communities did not have an Objective gap, they all still did poorly regarding this particular gap. Two communities; Vikolom 3 and San Miguelito received an average score of 5. The other three communities did not do a better performance where Quejchip, Visiban, and San Pedro Secal received an average score of 5.3, 5.5 and 5.5 respectively. The Objective gap occurs

when water-related objectives are not aligned with other objectives of the community. To help bridge this gap, priorities should be clearly formulated so that a community's resources can be used to achieve these objectives.

Accountability gap was identified by measuring two principle; Integrity and Transparency principle and Monitoring and Evaluation principle. An Accountability gap was not identified in any community. The two principles were satisfied across the seven projects. For Integrity and Transparency principle, all communities received the same average score of 6.2. As mentioned in section 10.1.6., this may refer to the cultural aspect of communities in terms of how they monitor the work of their water committee representatives. Moreover, it is up to the community how they create mechanisms to avoid corruption and how to handle it if it happens. The Monitoring and Evaluation principle was applied differently in each community. San Pedro Secal received the highest score (7) compared to other communities. This refers to the strong performance of the water committee in terms of monitoring the water system and ensuring to provide maintenance when needed.

Table 4 summarizes WGF gaps in each community:

Table 5: Policy gaps summary

Community	WGF Gap(s)
Quejchip	Information gap and Policy gap
La Libertad	Information gap and Objective gap
Vitostix	Information gap, Policy gap and Objective gap
Vijolom 3	Information gap and Policy gap
Visiban	No gaps identified
San Miguelito	Information gap and Policy gap
San Pedro Secal	Information gap

11.0 Conclusion

This study explored the OECD WGF and applied it to water projects completed in Guatemala by EWB@UWM. Six WGF were investigated through measuring eight principles. Principles were measured by extensive questionnaire, interviews, and site visits to the water projects and communities in Guatemala. Results have shown that only Visiban was the project that did not have any WGF gaps. The rest of the communities had at least one WGF gap. The Information gap appeared in all communities except for Visiban.

The OECD WGF does not provide practical methods and techniques to bridge the identified gaps. Hence, ACCMARI and EWB@UWM have to work closely with the communities to enhance the performance of the unsatisfied principles in order to bridge any present gaps. Communities have to decide regarding how they gaps should be bridged. In some cases, a community may decide to accept a gap, if it does not influence the functionality of the water system. However, community members have to reach a consensus among themselves to reach a decision.

The OECD WGF is a tool to identify gaps in water development works. Communities should be able to utilize this framework to improve the performance of their system and enhance its capacity. This can happen if the outcome of this study is shared with each community so that the members of the community are aware of what gaps are present. Additionally, a community can utilize this framework during planning phase. ACCMARI organizes meetings before, during and after installation of a water system. ACCMARI helps a community build capacity so that members can ask for what they need. During meetings that take place before the installation, it is important that community members, especially water committees' representative, to be aware of this framework so that efforts can be focused to avoid any possible gaps that may occur.

It is worth mentioning that in all water projects, water is flowing from the source to the household. Regardless, a WGF gap is present. Water systems have been meeting the users' demands in terms of receiving safe drinking water, yet consequential gaps indicate the project may not be sustainable on the long term or it may need additional support to remain successful. On the short run, the communities may not fully comprehend the usefulness of the OECD WGF tool. Since water is flowing in the pipes, then the water system is successful. The Financial gap, in particular, is viewed as the most crucial since lack of funding may result in incapability to build the water system. Hence, other gaps may not receive as much attention from the community. However, on the long run, the water system is the first step towards sustainable development within various sectors such as energy and agriculture. Each WGF gap plays a major role towards ensuring sustainable functionality of the water system as well as providing guidelines to implement development projects within the community.

As mentioned earlier, three main WGF gaps have been identified in almost all communities; expect for Visiban that does not have an Information gap. The three WGF gaps are Policy gap, Information gap, and Objective gap. None of the gaps resulted in a malfunction of the water system. However, bridging the gaps will enhance the system's performance and long term success. In the Policy gap, bridging the gap comes from defining roles and responsibilities for each stakeholder. The presence of this gap did not stop water from flowing to the households, however, acting upon responsibilities can avoid conflicts within the community that may occur due to unreliable behaviors of stakeholders. Moreover, the water committee should ensure that the oral contract between the users and ACCMARI is satisfied. In some cases, for instances, users may use their domestic water for agricultural purposes which is against the main objective of the water system that aims to supply water to households for domestic purposes. Bridging policy gap

will result in eliminating any type of conflict that has the potential within the community to occur.

The Objective gap should also be focused on to improve the fragmentation across different actors involved in the project. Similar to the Policy gap, the Objective gap does not constrain the water supply to the users. However, it may significantly hinder water policies in other sectors such as energy and agriculture. Objective gap can slow down the development process within a community since different rationales can create obstacles for adopting convergent targets. This can happen particularly when disputes reduce the political will to make decision or even to substantially engage in organizational development regarding the water sector.

The usefulness of the OECD WGF is not only limited to water systems in Guatemala. The framework can be applied anywhere to assess water sectors on national or sub-national levels of government, water infrastructure in urban areas, as well as water development in rural areas. However, the framework should be flexible to accommodate for differences between a place and another. For instance, if the framework was intended to be applied on water projects in Kenya, the principles should be investigated differently due to political, economic and social variations regarding the case study.

The framework can evaluate long term success. After WGF gaps are identified, efforts should be focused to bridge the gaps so that better performance is ensured with the water governance system. As a result, this will lead to improve water projects on different scales in the future as the framework provides a set of guidelines to ensure sustainable water development in urban and rural areas on different national and subnational levels of government.

External groups, particularly EWB@UWM, can utilize this framework as well. This framework offers a significant tool to evaluate previous water systems as well as assist in planning for future development works. The model used in Guatemala consists of three parties; ACCMARI, EWB@UWM and the community. Some WGF gaps, such as Funding gap, can occur due to the performance of the external group. Therefore, it is vitally important to evaluate the involvement of EWB@UWM as this group may be responsible for creating one or more WGF gaps. External groups hold responsibility in development works and their participation must be evaluated to ensure positive contribution to the project.

The OECD WGF was developed to evaluate the water sector on national and subnational levels of government. In this study, the framework was applied on off-grid small scale water projects in rural areas. This was a challenge since the framework did not accommodate for this type of water development. The framework should include new mechanisms that can be used to identify gaps in a systematic manner. Additionally, besides to the three main clusters; Effectiveness, Efficiency, and Trust and Engagement, a new cluster should be added. This new cluster can be named Assessment and should explore areas such as sustainability, durability, and individual's satisfaction. These areas can be defined as principles so that they can be measured to identify any possible gaps that may be present in a community. Lastly, the framework should include a component that assesses community development. This principle can be measured after a number of years from the installation to measure how the community has developed due to the water system.

This study is a pilot study of assessing and evaluating the completed projects in Guatemala based on the OECD WGF. For future works, it is important to compare the methodology used in this analysis with other works that took place in other rural places around the world. Second of

all, the questions used to measure principles be more systematic if this study is to be applied in other places. However, methodologies should be flexible to accommodate for political, economic and social differences. Lastly, this study did not answer the third research question listed in Chapter 3. A clear definition of sustainability should be formed and variables have to developed to accurately measure sustainability. This also includes determining a number of years where sustainability is measured to account for economic and social development.

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Appendix A

This appendix summarizes the questionnaire conducted during the interview with Mr. Ramirez, January 2016:

1. How was ACCMARI established?
2. What are the vision, mission and goal of ACCMARI?
3. What is the administrative and operative structure of ACCMARI?
4. How does ACCMARI gain trust from the served communities?
5. How many water projects have been completed by ACCMARI within the Ixil Triangle?
6. How does ACCMARI prioritize communities in terms of who gets a water system first?
7. How does ACCMARI maintain the completed water projects?
8. Could you please describe the served communities in terms of:
    - Capacity building
    - Earning trust
    - Payments and fees
    - Community committees
9. What are the main challenges that ACCMARI faces?
10. What is the role of municipal and national governments in the water development projects within the Ixil Triangle?
11. Could you please describe the relationship between ACCMARI and EWB@UWM?
12. What form of assistance is ACCMARI looking for from its partnership with EWB@UWM?
13. What does ACCMARI offer to EWB@UWM and the community?

Appendix B

This appendix summarizes the questionnaire conducted during the interview with Dr. Jablonski, January 2016:

1. How was the Student Chapter of EWB@UWM established?
2. What are the vision, mission and goal of EWB@UWM?
3. Why were Guatemalan communities, in particular, chosen to work with?
4. What are the main challenges facing EWB@UWM?
5. What does EWB@UWM offer to ACCMARI and vice versa?
6. Could you please describe the water projects completed by EWB@UWM in terms of:
    - Design
    - Funding
    - Work with ACCMARI
    - Project evaluation and assessment
7. How do you define the relationship between EWB@UWM and ACCMARI?

Appendix C

- **Principle 1**: ‘‘*Clearly allocate and distinguish **roles and responsibilities** for water policymaking, policy implementation, operational management and regulation, and foster coordination across these responsible authorities.*’’
    a. Is there a contract in place between ACCMARI and the community?
    b. Does the community have a water committee? How strong is their role? And understanding? Do they know their role and act on it?
    c. Do community members help with trenching? Infrastructure construction? Do they feel that they have a responsibility of the project during the project? Have they shown this in some way?
    d. Does the water committee take full responsibility for maintaining the system? Do they feel that they have a responsibility of the project after the project? Have they shown this in some way?
    e. Is the municipality involved in any sort of contractual agreement with the community, ACCMARI, or EWB@UWM? Do they feel that they have a responsibility of the project during and after the project? Have they shown this in some way?
- **Principle 3**: ‘‘*Encourage policy coherence through effective **cross-sectorial coordination**, especially between policies for water and the environment, health, energy, agriculture, industry, spatial planning and land use.*’’
    a. Does the community have a ‘new project’ committee? How strong is their role? And understanding? Do they know their role and act on it?
    b. Does the community have plans for future projects in the following sectors: environment, health, energy, agriculture, industry, or spatial planning and land use?

c. If yes, have ACCMARI, EWB@UWM, municipality and the national government been informed regarding these future projects?

d. How often do the heads of all committees of a community meet?

e. Are meetings documented so that absentees can learn about what has been discussed to better plan ahead?

f. Are meetings documented so that the municipality and the national government have on file some representation of the village?

- **Principle 5:** ‘‘*Produce, update, and share timely, consistent, comparable and policy-relevant water and water-related* ***data and information****, and use it to guide, assess and improve water policy.*’’

a. Does the community report problems to ACCMARI? How often? What makes them do this?

b. Does ACCMARI discuss problems (spring flow rate fluctuations, household usage allowance vs needs, home use vs irrigation use, community engagement, construction protocol, funding, EWB@UWM, municipality, national government support) with the community before installation takes place?

c. Does the community generate reports about their water consumption?

d. If these reports are based on another utility (such as electrical pump fed system whose reporting purpose is to pay the electrical bill), what is the opinion about the long-term benefits/disadvantages about this reporting?

e. For those who do not report water usage, is there any opinion of whether this may benefit the community in the future?

f. Does the community receive any information from an outside group (ACCMARI, EWB@UWM, Municipality, or the National Government) regarding their water project/quantity/quality that has helped the people of the community transform in any way (gain knowledge, education, understanding, international relations, diplomacy)?

- **Principle 6:** ''*Ensure that governance arrangements help mobilize water finance and allocate* ***financial resources*** *in an efficient, transparent and timely manner.*''
    a. Is there a treasurer in the local government within the community?
    b. Is there a treasurer for each committee elected by the community?
    c. Does the treasurer work with ACCMARI? In what capacity? Frequent or not?
    d. Does the community have the right to investigate the work of the treasurer?
    e. Does the treasurer (or whoever is responsible for community finances) share with the community budgetary reports on a regular basis?
    f. Is the public involved in determining obligatory fees such as maintenance fee, etc.?
- **Principle 7:** ''*Ensure that sound water management* ***regulatory frameworks*** *are effectively implemented and enforced in pursuit of the public interest.*''
    a. Does the water committee attend the ACCMARI semi-annual meetings? How often?
    b. Is there a contract in place that discusses the regulation of the water system between ACCMARI and the community?
    c. Does the water committee have the capacity to enforce the contract between ACCMARI and the community?

d. Is there anything in place if a community needs assistance from ACCMARI? Is that type of request appraised? Suppressed?

e. Is the community involved in deciding who receives a water pipeline? To what extent? Are there criteria that help the community decide? How extensive/organized is that criteria?

f. Does ACCMARI fulfill its responsibilities from the contract towards the community? How is that measured? On a success/failure scale, or access to Diego (is it the perception of the community that Diego and ACCMARI are accessible? Open for communication and to help? Or are they out of reach?).

g. Is the municipal government involved in enforcing the contract? Do they try? Do they have an opinion about the contract? No; Do they take ACCMARI seriously?

- **Principle 9:** ''*Mainstream **integrity and transparency practices** across water policies, water institutions and water governance frameworks for greater accountability and trust in decision-making*''.

a. Is the water committee elected by the community? Yes ; how involved is the community in that process?

b. Does ACCMARI share the water system design with the community before implementation? Do they take the time to explain? How many meetings do they hold?

c. Has the community encountered any corruption within its local government? With the municipal government? With ACCMARI? With the national government? With EWB@UWM?

d. Is the community informed about the project costs? What is the extent of their understanding of the costs? Is this in regards to their association fees to join ACCMARI? Do they understand the extent of what EWB@UWM offers? What about the municipality?

e. Does the community know when there is any form of assistance coming from the national or municipal governments? Who solicits? ACCMARI? EWB@UWM? Committee leaders? Villagers?

- **Principle 10:** ‘‘***Promote stakeholder engagement*** *for informed and outcome-oriented contributions to water policy design and implementation.*’’

a. Is there a meeting taking place with the community before installation starts?

b. Does the overwhelming majority of the community attend the meeting? Are all types of people represented? Women? Men? Children? Elderly?

c. Is the voice of women heard in the decision making process? Are their voices heard during the meetings? Is there anything in place to ensure that they are?

d. Is there a general consensus among the community to have a water system? What is this based on? How is this measured? Is there written or oral communication in these meetings? Is a majority vote enough or does there have to be total agreement?

- **Principle 12:** ‘‘*Promote regular **monitoring and evaluation** of water policy and governance where appropriate, share the results with the public and make adjustments when needed.*’’

    a. Does the water committee fully monitor the water system? How do they learn how to do this? Have they fully learned to do this? Is it something they actively learn and prioritize learning?

    b. Do they communicate the results with the community? ACCMARI? EWB@UWM? Municipality? National government? How do they do this? What do they think about this—is it required? Could it hurt them in any way? Is there anything preventing them from sharing the information with the other groups?

    c. Does the community receive technical assistance from ACCMARI regarding maintenance? How often? In what capacity? Is it offered by ACCMARI, or does it have to be solicited by the community? How do they learn that they can or cannot ask for assistance?

    d. Is the community informed about the functionality of their water system? Or do they understand the system so well that no one has to inform them?

    e. How often does ACCMARI monitor the completed project? Is it through the community government? Is ACCMARI responsible for this? Do they consider it their work, or the community’s?

    f. Does the water committee share information regarding their water system with other communities? Do they see themselves, being part of ACCMARI, as part of a large collaborative, cooperative, communicative organization? Or are there feelings of abandonment and isolation?