Global Water Partnership Central America

Implementation of Rainwater Harvesting Systems with a Geomembrane Bag in Honduras and El Salvador (#XXX)

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About GWP

The Global Water Partnership's vision is for a water secure world. Our mission is to advance sustainable development and water resource management at all levels.

GWP was created in 1996 to foster the implementation of integrated water resources management and help countries with sustainable management of water resources in order to achieve a water secure world, i.e. with a reliable availability of an acceptable quantity and quality of water for health, livelihoods and production, coupled with an acceptable level of water-related risks.

GWP is a neutral, pluralistic and broad-based network that facilitates processes aimed at building consensus and integrating efforts. It includes government institutions, universities, professional associations, research institutions, non-governmental organizations and the private sector.

The Network has 13 Regional Water Partnerships, 85 Country Water Partnerships, and more than 3,000 Partners located in 182 countries.

Content

1. Context

Water is a key driver of socioeconomic development in countries, as well as a vital element in the integrity of natural environments. The world gradually faces a growing demand for water while the availability of this resource decreases, which means that decisions regarding its management must be taken under a holistic approach. Based on this scenario, Integrated Water Resource Management is a process of coordinated development and management of water, land and related resources, in order to maximize economic development and social welfare in an equitable manner without compromising the sustainability of ecosystems.

Given the accelerated population growth, rapid urbanization and industrialization processes, the expansion of the agricultural frontier, and climate change, among other variables, IWRM has acquired a crucially important dimension in the international, national and local stage. It is considered the most comprehensive and adequate management model because of its adaptative nature in terms of physical and social determinants and its coordinated and equitable management across sectors for sustainable development.

Central America is one of the regions most affected by climate change. Its effects are reflected in more intense, recurrent and prolonged hydrometeorological phenomena located at opposite ends of the same spectrum: floods and drought. In turn, multiple factors, such as rapid environmental degradation, lack of land use planning, institutional weaknesses or lack of adequate infrastructure, make it one of the most vulnerable regions to natural hazards in the world. The Central American Dry Corridor (CSC) is one of those most affected.

To meet this challenge, GWP Central America has been involved in promoting and building capacity on Rainwater Harvesting Systems (RHS) within the framework of the Water, Climate and Development Program (WACDEP). It supports its implementation through the articulation of members and partner institutions, generating important achievements in technology transfer and gaining valuable experiences in technical and organizational aspects. It can also contribute to a better understanding of Integrated Water Resource Management (IWRM) and give interventions a gender perspective.

2. Background

Between May and July 2014, Central America suffered the effects of an ENSO phenomenon that caused drought and an irregular rainfall regime that prolonged the *canícula* (dry period in the middle of the rainy season) for up to 45 days in certain areas, leading to losses in sectors such as agriculture, hydroelectric power and drinking water supply. The impact to the latter was estimated at around US $ 1.5 million, not to mention the social cost to families and the impact to their quality of life. (GWP, 2016).

In Honduras, the drought affected 76,712 small-producer families in 64 municipalities across the country's southern areas (GWP, 2016). In 2013, CARE, within the framework of the PROSADE project, joined forces with MEXICHEM - AMANCO to develop a research project aimed at finding a technological solution to supply water to these communities. The result was a rainwater harvesting system using geomembrane bags. In 2016, GWP Central America and Zamorano came on board to disseminate the technology at the regional level and build capacity in its use via a Central American workshop based on IWRM and climate change and aimed at women from rural communities in the region. The workshop used a gender approach in order to promote women's involvement in water management and the use of this technology.

One of the women who participated in the workshop was the mayor of the municipality of Jerusalén, who is also a member of the Jiboa Valley Women's Network in El Salvador. She requested that the workshop be replicated in El Salvador in order to contribute to improving the population's access to water through the use of the geomembrane bag technology. Thus, the partnership that started with GWP Central America, CARE, MEXICHEM and Zamorano in Honduras expanded to include the Association of Municipalities of the Jiboa Valley, the National Foundation for Development (FUNDE) and Mexichem El Salvador, to transfer the technology and set up a demonstration system in the municipality of Jerusalén.

3. Description of the Problem

3.1. Drought in Central America

In Central America, drought is cyclical and usually closely related to the El Niño - Southern Oscillation (ENSO) phenomenon. The Central American Commission for Environment and Development (CCAD) reports that some ten ENSO events - lasting between 12 and 36 months - have been recorded over the past 60 years (FAO, 2012).

It is important to note that drought in Central America is mostly related to anomalies in rainfall distribution during the rainy season, especially to when it stops during the *canícula* and when it resumes. On average, droughts last approximately two and a half months (79 per cent of the 1800 cases documented) and only during highly critical events does it extend through to the *postrera* period [1] (FAO, 2012). Central America has experienced drought in 2009, 2012, and 2014 extending into 2015, and a new ENSO phenomenon is expected in late 2018.

Honduras: The 2014 drought affected 76,712 families in 64 municipalities across ten departments in southern Honduras. A national emergency due to drought was declared, and the National Water and Sewerage Service (SANAA) resorted to rationing the water supply, making it even harder to access water for consumption. A total of 246 micro-basins were found to be

[1] The "*Postrera* Period" refers to the second growing season of the year, which is usually after the *canícula* between August and September. This term is mainly used to refer to the planting of corn and beans.

vulnerable due to the scarcity of water, and 84,536 additional tons of CO_2 were produced because of the drought (GWP, 2016).

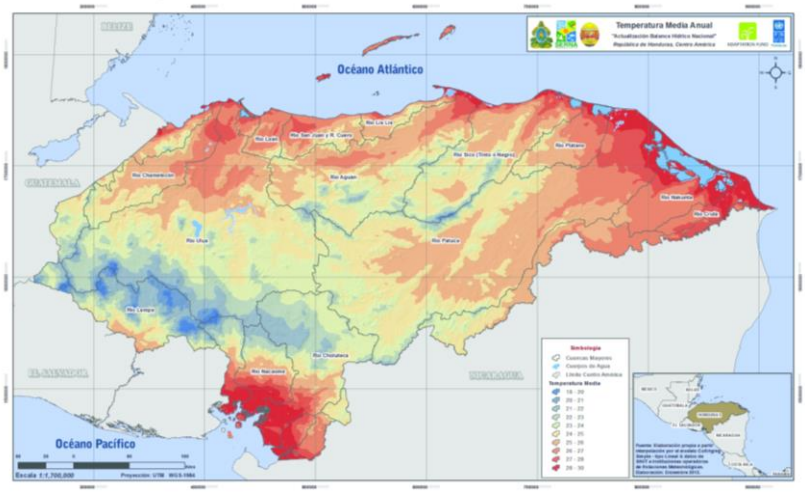


Figure 1: Annual Average Temperature (mm). (Source: Facing climate risks in terms of water resources in Honduras project)

The orientation of the mountainous area that makes up the continental watershed has a significant impact on the rainfall regime. The southern portion of the Honduran dry corridor is where the least number of rainy days and the highest temperatures are recorded; however, the influence of the sea causes it to experience the most intense rainfall compared to the rest of the country (up to 2000 mm/year). This is a valuable opportunity for resilience (GWP, 2015).

Area	Average maximum temperature (°C)	Driest months	Rainiest months	Relative humidity (%)	Rainy days	Annual average precipitation (mm)
Atlantic Littoral Zone	30	Apr - May	Jun - Nov	82	167	2.643
North of Interior	30	Jan - Apr	Jun - Nov	75	150	1.128
Central	27.1	Jan - Apr	May - Oct	70	118	1.004
Western > 1.400 m.	23	Dec - Mar	Apr - Nov	76	160	1.290
Western < 1.400 m.	23	Dec - Apr	May - Nov	76	144	1.395
Eastern	30.2	Dec - Apr	May - Nov	74	153	1.200
Southern	**34.4**	**Dec - Apr**	**May - Oct**	**66**	**102**	**1.680**

Table 1: Water Balance (Source: UNAH-IHCIT-MiAmbiente, 2013)

El Salvador: Droughts happen periodically, reoccurring with lesser or greater intensity at the beginning of a rainy season and prolonging the transition into the dry season. These can also occur at the end of a rainy season, shortening its duration in October and other times during the *canícula* in August.

The drought during the first half of 2015 had a significant impact on drinking water supplies for human consumption. According to El Salvador's Ministry of Environment and Natural Resources

(MARN) reports, by August the flow of the Lempa River had been reduced by 87 per cent, the most critical numbers in 18 years regarding the country's main basin (El Mundo, 2015). The reduction in flow was even more drastic for the Torolá River in eastern El Salvador - a 95 per cent reduction in relation to historical averages for the month of June (MARN, 2015).

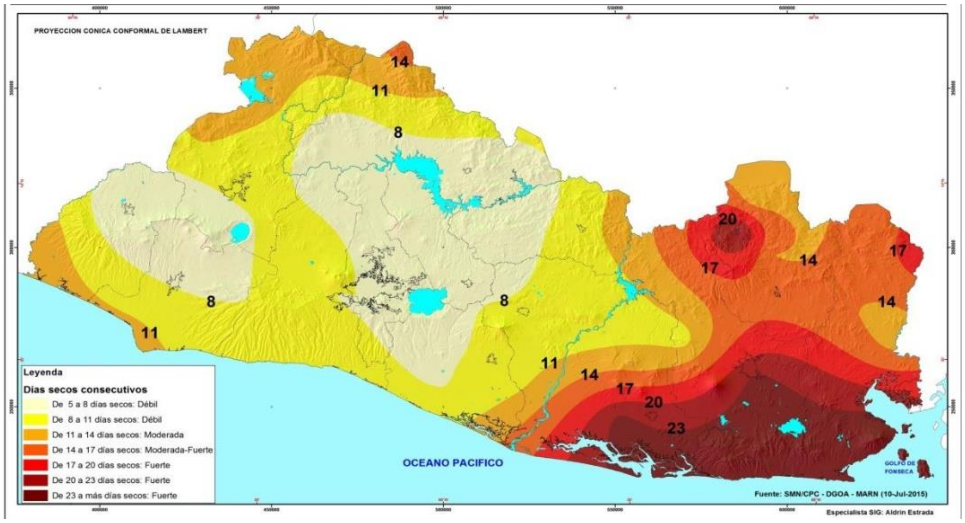
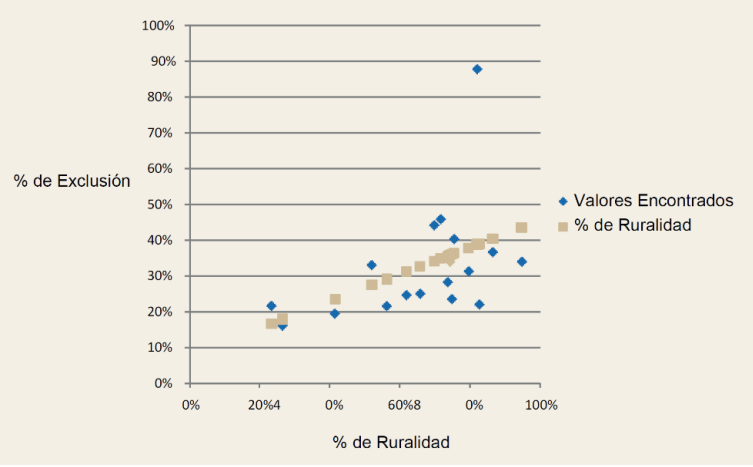


Figure 2: Consecutive dry days between June and July 2015 in El Salvador. (Source: SNET 2015)

3.2. Inadequate coverage – Lack of infrastructure

Honduras: In-home water coverage in rural Honduras is 66 per cent, which drops to 56 per cent if availability is factored in (JMP, 2017). Most rural systems are managed by Water Management Boards. It has been observed that most of the communities excluded from service coverage are those with fewer than 500 inhabitants, and that such exclusion increases as the number of inhabitants decreases and their level of rurality increases (UNICEF, 2011).



Graph 1: Correlation between exclusion and proportion of rural population (Source: Study on exclusion in the water and sanitation sector in Honduras, UNICEF 2011).

It was also concluded that the national strategy to expand coverage is centred on creating new systems, prioritizing communities located within "Honduran Economic Corridors". Furthermore, SANAA establishes a minimum of 20 dwellings for investment in this regard, which excludes 18,785 communities (9.68 per cent of the country's population in 2011) (UNICEF, 2011). This makes these communities' situation even more precarious in terms of water supply, requiring the use of alternative non-conventional technologies tailored to local conditions.

El Salvador: Given the legal gap regarding water issues due to the lack of a General Water Law in the country, the provision of water supply services in rural and peri-urban sectors has received little attention. Entities such as the Social Investment Fund for Local Development (FISDL) have built works in rural areas coupled with training to Water Management Boards; however, its role in terms of monitoring, technical assistance and post-construction operations has been limited. The purpose of creating the Office for Services to Rural Systems and Communities within the National Aqueducts and Sewers Administration (ANDA) is to develop a comprehensive technical assistance and management model that involves the entities responsible for managing drinking water and sanitation systems in rural areas and communities in the country, in order to build local capacity for the sustainability of interventions.

According to Joint Monitoring Programme data (UNICEF/WHO-JMP), it is estimated that 77 per cent of the rural population has access to in-home service, but it is only available on demand to 59 per cent. These data differ considerably from those provided by ANDA, according to which coverage is 42.7 per cent, of which only 12.9 per cent correspond to in-home connections and 29.8 per cent are served through public reservoirs and *cantareras*[2] (ANDA, 2017). This difference may be due to differences in criteria and sources; either way, in the best-case scenario more than half a million Salvadorans in rural areas still lack water supply.

According to statistical data provided by ANDA, San Vicente, which is the subject of this case study, is one of the departments that has made the least progress in terms of water and sanitation in the last five years, as shown in the following table:

Department	Population (2018 projections)	Year 2012		Year 2014		Year 2016	
		Cantons and communities	Services	Cantons and communities	Services	Cantons and communities	Services
Ahuachapán	367,569	4	3.321	4	3.514	4	3.648
Santa Ana	593,725	5	1.489	8	2.260	8	2.345
Sonsonate	511,304	4	631	4	731	4	737
Chalatenango	206,859	3	213	4	380	6	489
La Libertad	813,017	5	8.639	6	9.288	9	12.129
San Salvador	1,797,131	4	6.582	4	6.744	5	7.718

[2] Big clay jars for water storage

Cuscatlán	269,493	3	88	3	88	8	1.556
La Paz	366,879	13	1.775	15	1.822	18	4.610
Cabañas	169,683	4	90	3	53	6	1.388
San Vicente	**186,110**	**3**	**272**	**3**	**284**	**3**	**284**
Usulután	378,667	41	3.484	60	4.944	69	6.263
San Miguel	505,300	44	3.309	64	3.935	64	4.302
Morazán	206,186	11	413	11	413	11	413
La Unión	271,436	47	5.256	47	5.507	47	5.705
Total	6,643,359	191	35.562	236	39.963	262	51.587

Table 2: Cantons and communities with rural water service, by department - 2012-2016. Source: ANDA 2017

3.3. Implementation of Integrated Water Resource Management

As part of the process to prepare for the 2015 World Water Forum, water managers in the region identified that water security as the reference framework for articulating water use and conservation with national development targets and goals in each country was a key priority, and that IWRM was the means to achieve it (GWP, 2017).

El Salvador's National Basin Management Strategy found that the management plans implemented to date focused on soil recovery in productive plots, but ignored watershed degradation prevention to the point that almost all basins had been classified as highly deteriorated at the time of the study (MAG, 2017). The governance thematic focus within El Salvador's National Integrated Water Resource Management Plan diagnosed an absence of a water culture and low participation in water resource management by the population. It recognizes the importance of implementing governance measures, the duty to develop a new water culture and the need to engage the entire population in IWRM by having them assume roles in local management.

In Honduras, the adoption of the General Water Law facilitated the definition of citizen engagement mechanisms, establishing the Basin Councils as local water resource management bodies (GWP, 2017). These, however, have not yet been implemented in a massive way, as one of the weaknesses identified is people's lack of awareness of IWRM issues, which in addition jeopardizes the sustainability of existing interventions.

It is important to mention that both countries have community figures such as the Water Management Boards, which are spaces for community engagement in which members assume an active role in improving access to drinking water and conservation of water sources in their communities.

3.4. Gender

Worldwide, women and girls spend an estimated 200 million hours a day collecting water. According to estimates, this task is performed 64 per cent of the time by women and 8 per cent by girls vs. 24 per cent by men and 4 per cent by boys (BID, 2018). A regional workshop

organized by the Spanish Cooperation Agency for Development (AECID) found that there were two gender gaps most perceived by women in terms water and sanitation issues: One is a cultural gap, in which the women's work was limited to obtaining the water, specifically when it came from precarious sources. The building, operation and maintenance of systems were considered "men's affairs". The second gap is related to spheres of power. Women are usually excluded from performing tasks considered valuable for managing systems, and are relegated to subordinate positions with no decision-making power.

IWRM is based on the principles defined at the 1992 International Conference on Water and the Environment in Dublin. The third principle states that women play a central part in the provision, management and safeguarding of water. GWP adheres to this principle. Its gender strategy singles out three challenges that prevent women's meaningful participation and their positive influence on an equity perspective in policies and practices:

- Gender mainstreaming policies and practice
- Creating an enabling environment for women's meaningful participation in all aspects of water management for sustainable and equitable development
- Gender equality in the workspace.

4. Decisions and Actions Taken

As a result of efforts in comprehensive drought management, GWP has been involved in promoting and building capacity related to rainwater harvesting systems (RHS) through pilot projects. In late 2015, CARE and Mexichem decided to join this effort to disseminate the geomembrane bag technology at the regional level, strengthen existing capacity in this regard and promote it as a viable alternative that could become part of public plans or policies.

The decision to use rainwater harvesting systems (RHS) was based on the fact that it is one of the measures most promoted by governments to deal with drought, its practicality, the fact that it utilizes existing infrastructure and the multiple potential uses for the water that is collected. The geomembrane bag was promoted as a means for storage, since it had been determined that these systems' most expensive component was precisely storage. This technology was chosen based on a cost/benefit analysis that considered it to be the most viable option given the communities' characteristics (acceptance, storage capacity, ease of repair, among others).

The partnership's first intervention involved installing a system in a school in the community of Los Balcanes in Choluteca department, Honduras. This was the first time that a system would be installed in a school and at the community level. This first experience was shared at a regional workshop organized by GWP Central America and its partners and held at the Zamorano campus in April 2016. Through this workshop, GWP promoted an IWRM approach and redesigned the intervention to include a special focus on gender, in order to strengthen women's role in water

management as well as their skills and capacity in areas such as basic plumbing and RHS installation, thus ensuring sustainability of water security-related actions at all levels.

Figure 3: Price comparison between storage options (Source: CARE/PROSADE)

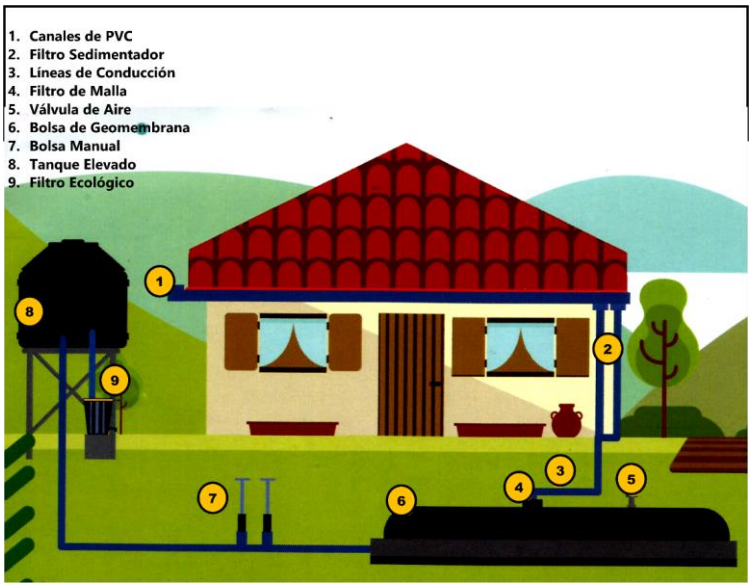


Figure 4: Diagram of the system and its components (Source: Mexichem)

The regional training workshop, which included both theoretical and practical aspects, was attended by 24 women mostly from rural communities across the isthmus and linked to water management associations. Practical sessions included setting up a demonstration system in La Ciénaga, a community near the Zamorano campus, which complements a GWP/Zamorano initiative that is part of WACDEP pilot projects aimed at improving community bio-intensive garden yields. One of the women who attended the workshop was the mayor of the municipality of Jerusalén in El Salvador, who requested assistance to transfer the technology in her community.

This is how GWP Central America and the rest of Consortium institutions, FUNDE and Mexichem El Salvador became partners to carry out the pilot intervention to install a geomembrane bag system in El Salvador. The intervention was funded by GWP and Mexichem, which were also in charge of providing technical support. This intervention took place in 2016 and involved the Jiboa Valley Association of Municipalities (MIJIBOA) and the Jiboa Valley Women's Network. The pilot project's implementation process included a practical workshop intended to provide training on IWRM, gender, leadership and technical aspects related to the systems, in order to later demonstrate the system's installation in Jerusalén. The purpose of the pilot was to promote its replication in the rest of communities and municipalities in the Jiboa Valley.

Image 1: Installing the bag in **Jerusalén**

Image 2: IWRM workshop

Under FUNDE's management, the project was expanded to six additional communities - Verapaz, Tepetitán, Apastepeque, San Sebastián, San Vicente and San Lorenzo - with funding from Australian Aid (Embassy of Australia in Mexico) and the Ford Foundation.

5. Outcomes

Technology transfer and trialling: The technology was successfully replicated across countries and adapted to different service levels (household, community, school, micro-irrigation, etc.). In addition, the technology was widely accepted at the community level, including a variation of the original concept introduced by GWP to adapt it to the Salvadoran context. In El Salvador, some 175,000 litres of water have been harvested from seven bags, and beneficiary families are saving up to US$ 90 dollars a month on water.

Beneficiaries: A total of 1,223 people benefitted from the implementation of seven bags in the Jiboa Valley, of which 58 per cent were women, who led the interventions in their communities. Beneficiaries are distributed as follows:

Municipality	Men	Women	Families

Jerusalén	25	38	17
Tepetitán	31	27	13
Verapaz	70	130	72
San Sebastián	75	90	50
Apastepeque	185	225	410
San Vicente	42	78	30
San Lorenzo	95	115	41
Total:	523	703	633

Table 3: Distribution of beneficiaries in Phase I of the project in El Salvador. Source: FUNDE, 2018

Standardization and sale: Based on the pilot projects, Mexichem, which is both a supplier and a partner of the Consortium, developed a standardized system that is distributed as a complete kit with components that are available in most hardware stores in both countries. This makes it easier to adopt and repair if needed. This has also led to using this technology in initiatives promoted by other institutions, including government projects.

IWRM and gender: IWRM was established as the main focus of training. The gender component was added as a priority approach at the time of implementation, which is mainly reflected through capacity building in leadership skills, water management, and technical and practical aspects of plumbing as a way to the enhance skills of and income alternatives for participating women.

Dissemination and replicability: With this initiative, GWP has contributed to articulating and involving local governments, non-governmental organizations (CARE, FUNDE), academia (Zamorano), private companies (Mexichem), cooperation agencies (Australian Aid) and the community, which has ensured the dissemination of the technology as well as coordination of both technical and financial efforts, with good results. The local governments' ownership has also been essential for replicating the initiative in other municipalities and regions.

The initiative has also transcended into other spaces. In 2017, Vilma Chanta, who is a member of FUNDE, of the Central America Water Youth Network, and who participated in adopting the technology in El Salvador, was one of 13 applicants selected from among 800 to be part of the Young Water Fellowship programme. The US$ 5,000 seed capital she received has been used to increase the number of beneficiaries in Phase II of the project.

In 2018, the dry period lasted longer than expected in Honduras, seriously affecting the rural sector. In response, the Central Government, through its Strategic Investment Office (INVEST-H), in partnership with CARE, decided to launch a public tender to acquire rainwater harvesting systems with geomembrane bags to address the impacts of the drought in southern Honduras.

6. Lessons Learned

- The space required to install the bag makes it a solution better suited for rural sectors, especially if it is to be implemented in residences. It is possible, though, to find other options that fit the local context.

- The community approach adopted in El Salvador has generated cohesion among residents, and the gender approach has promoted the leadership of women as the systems' builders and managers. This has contributed significantly to building their confidence and enhancing their role as decision makers in their communities' water security

- FUNDE's team modified the original design, enlarging the diameter of pipes from the manual pump and removing the float or buoy from the tank to facilitate and optimize manual pumping. This shows that technology needs to be adapted to the local context.

- During the dry season, people have modified the bags' original purpose (collecting rainwater) and are using it as an additional reservoir capable of storing large quantities of water supplied by ANDA.

- The fact that the technology was developed in partnership with Mexichem made the kit's components easily repairable because parts are standard. The degree of penetration in the sector facilitates availability and stock, which indicates that it is necessary to establish partnerships with the private sector to develop innovative technologies that respond to local needs.

7. Conclusion

In the context of climate change, droughts and floods mainly affect the dispersed rural population, which is usually the one that lacks the infrastructure to adapt to new challenges. The rainwater harvesting system with geomembrane bag has proven to be a successful technology since its development, so much so that it has managed to achieve effective articulation among actors from different sectors, something that is not a commonly seen in the region. Its adoption and wide acceptance show that, thanks to its technical simplicity and wide availability of components, it can be an effective alternative in places where conventional systems are not considered.

Several GWP Toolbox tools are used in planning and implementing this technology:

- Investment frameworks (A3.01)
- Community-based water supply and management organisations (B2.03)
- Civil society organisations (B3.03)

- Building partnerships (B4.03)
- Promoting social change (C8)

The workshops held prior to implementation are excellent IWRM training and ownership spaces. The gender approach that GWP decided to adopt allows building women's technical and management capacity, and has contributed to promoting women's leadership in decision making regarding water security, a role that is recognized by members of their own communities. All this has attracted the attention of and funds from international programmes, and will lead governments to have confidence in the initiative and to start investing in it as a viable solution for comprehensive drought management.

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9. Contact Details

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10. Supporting References

The construction guide for the rainwater system can be accessed at:

http://www.repo.funde.org/1475/1/cartilla.pdf

The regional workshop report can be downloaded from:

https://www.gwp.org/globalassets/global/gwp-cam_files/informe-taller-agua-lluvia.pdf