

Community Aqueducts and their Water User Associations in the Fuquene Lake Basin, Colombia

Last Updated:

August 1st, 2023

1. Static Analysis - Collective action

This case's biophysical context is the Fuquene Lake basin and focuses on the domestic use of water resources in rural areas. The basin is located on the western slope of the Eastern Andes Range of Colombia, between 7,800 and 12,300 feet above sea level, has 198,000 ha, and includes the sub-basins of the rivers Alto Suarez and Ubate. Located in the lower basin at the Chiquinquirá-Ubate Valley is the Fuquene Lake, an ecosystem with great significance to the local population. Most efforts concentrate on recovering the Lake's body of water and its riparian corridors.

The basin's self-organized Water Users Associations (WUA) provide water services to rural households. WUAs maintain the community aqueducts, mostly consisting of networks of canals and tanks, to ensure the provision of water to 59% of the basin's population. Only some WUAs have access to drinking water treatment plants. The WUAs occasionally undertake actions to improve local adaptability to current and future challenges due to water scarcity. Financing for infrastructure and adaptation projects may come from public resources, water service bills, unpaid work of rural inhabitants who need the infrastructure, or contributions made by external actors.

Over time, WUAs leaders have learned to manage resources to maintain the infrastructure of the community aqueducts and have gained experience as water service providers. However, socioeconomic dynamics deteriorate WUAs-leaders' capacity to self-organize and be autonomous. At the same time, the lack of public instruments that align with the conditions of the territory and consider communities' limited access to water management technologies impacts the efficiency and effectiveness of WUAs.

1.1 The Commons Dilemma

The dilemma around using common resources is due to water shortage, loss of trust (among residents and between them and the State government entities), and finding funding to sustain community aqueducts. Local community organizations and Non-Governmental Organizations (NGOs) promote adaptation, protection, and recovery of ecosystems and biodiversity

conservation. However, certain socioeconomic factors hinder collective action and exacerbate the shortage problem.

Unequal access to the resource: This is due to various causes: (a) The annual rainfall variability is more significant in the north than in the south, causing more water stress in the northern portions of the basin, particularly during the dry months of the year; (b) The investment of public resources to manage water resources and to build infrastructures for domestic water service is distributed unevenly across municipalities; (c) Economic inequality between sectors of the population causes low water service provision for the poorest families concentrated in the upper basin; and (d) Power inequalities among portions of the population impact WUAs operations because WUAs' leaders in areas with low political representation, struggle with finding means to maintain community aqueducts and building new infrastructures.

Water resources reduction: This is primarily due to: (a) The historical transformation of natural coverage and the draining of flooded areas and water bodies, which has led to the drying up of springs and stream-flow reduction in rivers and streams; (b) An increase in resource demand in recent decades; and (c) Surface water pollution from the runoff of agrochemicals, the lack of home wastewater treatment systems, and point-source pollution by the discharge of untreated industrial and domestic water into water ecosystems.

Weakened local human capital: Human capital is affected by: (a) The fragmentation of the community (due to migration of the population to other areas of the country), the transformation of cultural landscapes and changes of value assigned to nature by locals, and the introduction of the dairy industry that has impacted the local economy; (b) Clientelist relations cause greater dependence on the government's assistance, reduces the capacity of community leaders to self-manage, and impairs local communities resilience; (c) Solutions provided by the State and other external entities to solve WUAs' dilemmas, focus on actions that have little contribution to local human capital, for instance, engagement of local communities proposed by water management plans focus on activities that seek to improve environmental awareness among local communities, such as environmental education, rather than strengthening WUAs leaders' management and technical capacities, which could have a more significant impact on WUAs' self-governance.

1.2 Biophysical Context (IAD)

Natural Infrastructure: Land use of the basin is distributed among pastures for livestock (35%), agricultural areas (53%), and forest and páramo ecosystems (12%). Despite the historical transformation, the basin has a Regional District of Integrated Management (DRMI Fúquene-Cucunubá-Palacio) that protects remaining aquatic ecosystems, riparian corridors, páramos, and forests. Recently adopted climate-change-adaptation plans promote financial, social, and human capital investments for reforestation and ecosystem restoration in the basin.

Hard Built Infrastructure: Community aqueducts cover 59% of this basin's population, and most of its infrastructure was built between 1960 and 1990, with ongoing improvements. Community aqueducts' infrastructures consist of channels, weirs, gates, irrigation networks, access roads for maintenance, and drinking-water treatment plants with limited coverage. Rural populations without access to community aqueducts use rudimentary and low-cost technologies to capture and treat rainwater. Around Fuquene Lake, infrastructures to mitigate and reduce flood risk (mostly levees and perimeter canals) have been built. Locals also use infrastructures to access and extract resources from the Lake, such as piers and boats. Those who still fish in the Lake use nets and harpoons; however, the fishing economy has significantly reduced since the end of the 20th century due to the eutrophication of Fuquene Lake. Dredges and boats assist in evacuating non-native aquatic plants (water hyacinth - *Eichhornia crassipes* - and elodea - *Egeria densa* -) from the Lake's body of water. Finally, adaptation projects involve installing fences to protect aquifers' recharge areas, tanks to store water, and expansion of capture and distribution networks.

1.3 Attributes of the Community (IAD)

Social Infrastructure: At the basin scale, the Autonomous Environmental Corporation of Cundinamarca (CAR) is the State entity responsible for designing and implementing environmental management policies and plans and ensuring the sustainable use and protection of natural resources. The basin covers part of the departments of Cundinamarca and Boyaca. At this scale, departmental governments are in charge of regulating and monitoring water service providers. The basin covers 12 municipalities in Cundinamarca and 5 in Boyaca. At this scale, municipal governments resolve conflicts over water use and manage the designated annual budget. This budget comes from the central government to cover expenses related to community aqueducts, conservation of water resources, and projects to adapt to climate change. There are 204 villages, and 147 of them have access to community aqueducts. At the village level, the WUAs are the entities that provide domestic water service. There are 128 WUAs, each serving an average of 86 homes.

Human Infrastructure: Some WUAs' leaders are efficient administrators and managers, but most need more access to specialized knowledge. Leaders who consistently work on formulating adaptation projects and completing applications to access public resources, learn more, and have a more significant impact on the self-management capacity of their WUA. Several acquired leadership skills while working with JAC, which stands for Junta de Accion Comunal in Spanish (community action boards), a community organization that has existed in the basin for over 50 years. A JAC can occasionally serve as a Water User Association. However, JACs' primary role is to make local decisions and orchestrate collective action for rural populations' well-being. Historically, the JACs contributed to the economic development of the basin and actively participated in the construction of road and service infrastructure. Other types of community associations, such as agricultural and livestock cooperatives, campesino associations, and artisan

foundations, are responsible for training the population on various topics, controlling the price of milk, contributing to the improvement of agricultural practices, and participating in the maintenance of roads, in addition to collaborating with external actors for the protection of strategic ecosystems in the basin.

1.4 Rules in Use (IAD)

Boundary Rules: Households within a village are the beneficiaries of the service or "users." The WUA is a body of self-organized users composed exclusively of community members. WUAs are not required to join the JAC or any other pre-existing community organization in their formation. Neighbors can collaborate to solve problems related to water service, even if they belong to different villages. Public and private companies only provide the service in urban areas. However, on occasion, WUAs can provide water service to fractions of urban communities. To approve the creation of any WUA, a quantity equal to half plus one of the total number of households within a village is required. Suppose the beneficiary population of the service within a village is less than this sum. In that case, the competent authority in the municipality may authorize a single WUA to manage the water provision to more than one village.

Position Rules: Once affiliated, users are recognized as members of the WUA and can hold positions within the board. The WUAs are responsible for providing the water service.

Choice Rules:

Informal Rules: Users must affiliate with a WUA to access the water service and pay a fee. WUAs must ensure that there is the necessary infrastructure for capturing and transporting water to homes. WUAs must manage financial resources for their operations, including constructing and maintaining community aqueducts' distribution system. WUAs must be appropriately registered and their documentation updated to access state resources. If the WUA is not registered, it can provide water services, but it cannot benefit from the financial support offered by the State. WUAs are authorized to advance adaptation projects that ensure the provision of water service in the future. A WUA may only interfere with the work of another WUA if requested to do so. During water shortages or when the WUA cannot provide the service, users must temporarily solve access to the water resource.

Formal Rules: WUAs that provide the water service are obligated to: (a) Utilize water efficiently and economically in the place and for the object stipulated in the concession resolution, using technical systems of use; (b) Not use more water than granted; (c) Build and maintain installations and hydraulic works in adequate conditions; (d) Prevent spillings and water diversion from streams and channels; (e) Contribute proportionally to the conservation of hydraulic structures, surveillance paths, and other standard works and installations. (Article 133 of Decree 1608 of 1978, from the Presidency of Colombia).

Information Rules (Formal Rules): WUAs must provide data on water use (Article 133 of Decree 1608 of 1978, from the Presidency of Colombia). The competent environmental authority (CAR, for this case) will organize and maintain a registry of domestic water consumption in dispersed rural homes and domestic wastewater from individual essential sanitation solutions. (Article 1 of Decree 1210 of 2020, from MINAMBIENTE).

Aggregation Rules: The general assembly of the WUAs will meet once a year to review financial balances, make decisions on the investment of resources, adjust statutes and tariffs, review and approve maintenance, expansion, and adaptation projects, and approve extra charges. Every two or four years, the board of the WUA is elected, composed of the president, vice president, secretary, board members, a legal representative, and a fiscal reviewer.

Payoff Rules: Users may discharge domestic wastewater on the ground provided that they have essential sanitation solutions to treat domestic wastewater designed under the parameters defined in the Technical Regulations of the Potable Water and Basic Sanitation Sector (Article 3, Paragraph 5 of Decree 1210 of 2020 from MINAMBIENTE) and that they pay for WUA's services. WUAs must ensure that the water delivered to homes must be suitable for direct drinking, preparation of food, immediate consumption, and satisfaction of all other domestic needs, such as personal hygiene, utensils, and materials (Article 2.2.3.4.1.1. of Decree 1210 of 2020 that modifies Decree 1076 of 2015 that regulates Article 279 of Law 1955 of 2019 from MINAMBIENTE).

Scope Rules (Formal Rules): The water resources used by WUAs can be from surface or groundwater. State entities at the department and municipal levels must monitor and control compliance with norms; therefore, there must be inspection, surveillance, and control of water resources. (Law 99 of 1993, from the Congress of the Republic of Colombia). Water-service users can impose popular actions against state entities obligated to monitor and control compliance with norms. (Article 2.2.3.2.20.4 of Decree 1076 of 2015 from MINAMBIENTE).

1.5 Summary

In addition to the problem of water shortages, particularly during the dry months of the year, the Water User Associations (WUA) face financial challenges in their operation. WUAs leaders' capacity to manage community aqueducts and provide domestic water services relies on empirical knowledge; most have yet to receive training in drinking water management, and many need to learn how to manage public resources. Therefore, most of these leaders need more experience and knowledge to fulfill the requirements imposed by cooperation agencies in their funding programs. External actors, such as NGOs and Universities, support community work and provide a bridge between local actors and state entities, particularly concerning the recovery and protection of strategic ecosystems and biodiversity conservation. Clientelist interactions between WUAs leaders and municipal governments reinforce the communities' dependence on the State. Environmental management and planning policies and actions do not promote WUAs'

self-management capacity nor strengthen the technical knowledge of WUAs leaders. The formal rules regulating the WUAs must align with the capabilities and technological opportunities available in the territory.

2. Case Contributors

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3. Sources

3.1. Studies on commons

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