3 Upstream, Downstream

Accounting for the Environmental and Social Value of Water in the Andes

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Water and irrigation are fundamental to food production globally. Institutional and regulatory frameworks for water in Latin America prioritize agricultural use, creating perverse incentives to maximize water use without control. In general, water quantity and quality are not effectively measured nor paid for, and management decisions are neither transparent nor accountable. Therefore, True Cost Accounting (TCA) can provide a framework to better measure water stocks and flows, understand environmental limits, and inform financial decisions over time.

Three case studies from Colombia, Peru, and Ecuador and additionally Mexico, Rider B provide examples of social and environmental values of water recognized by voluntary advocacy. Payments have been accompanied by grassroots decisions to develop regional and national policies for reliable access to water. They describe how agriculture water users in the Andes, working with governmental water regulators and non-governmental organizations, have internalized the costs of source-water protection into their practices, rates, and policies. Sugarcane farmers and processing plants in Colombia's Cauca Valley pay a voluntary tariff through a centralized water fund to support upstream conservation practices that protect the source of their irrigation water. Agricultural communities in Ecuador and Peru have been empowered to work with water management districts to approach water use and protection in a more holistic fashion. Their ancestral practices and recognition of water's multiple values—a TCA approach—can improve water availability and crop production over the landscape.

Introduction

Farmers around the world are experiencing diminishing water flow, quality, and timeliness. As their lands are interconnected to the ecosystems that sustain them, cumulative environmental impacts generate unforeseen results, affecting farming viability itself. A great example of this feedback loop is water use in farming, which is the principal use of water throughout the world. The water cycle, if not well understood and managed, can lead to extreme impacts and a “tragedy of the commons” that threatens the viability of the individual. Therefore, there is a fundamental need to better understand, quantify, and price

nature—in this case, water—to guarantee safeguards and warning signals so that individual and collective decisions are sustainable (Daily and Ellison, 2002).

The Andes of Colombia, Ecuador, and Peru are part of this reality. As a vital agricultural region where water is traditionally abundant and managed, people assume that water should be available for everyone, all the time. Traditional highland communities have long-term visions and values that allow them to recognize the signs of deterioration of their water sources. Over the past four decades, agriculture and urbanization have intensified across the region, forest loss has increased, and water pollution has gone unchecked. As a result, water quality and year-round flows are greatly threatened. For example, Quito, the capital of Ecuador, has seen water flow reduced by 12–34% in its more than 200 intakes (R. Osorio; personal communication, January 2020). Consequently, water has to be brought to the city from more distant sources: 24 km in 1957, 73 km in 2011, and now an estimated 110 km for drinking water projects that are being planned for the future. Command-and-control policies have been established to address these problems, but enforcement has been limited, and cultural norms tend towards informality. Therefore, water management continues to be overregulated for agricultural users who respect the law. In other cases, regulation is not respected, creating free-for-all situations. These parallel worlds generate greater disparities and promote social conflict, creating unjust and unsustainable conditions for the very poor (Boelens, 2008). Transparency is needed so that all water users and regulators work from the same information, take collective action, and enforce the same set of rules for everyone.

Water Must be Priced to Include Source Protection

Agriculture fails to pay for the true cost of water, both in terms of quantity and quality, and the protection of the ecosystems that source it. The agricultural sector, being the leading user of water, pays the least per unit of water. Typically, some components of the total cost of agricultural water, for example, source protection measures and wastewater discharge impacts, are not included nor estimated completely and effectively. Water rates tend to be flat, and there is little innovation in costing.

In the northern Andes, if agricultural water is charged, enforcement might be lax. Furthermore, the irrigation rate does not cover all its costs; the capital costs of gray infrastructure such as dikes, canals, and uptake structures required to distribute the water, are not always included. If groundwater is being pumped, depletion rates are not respected. Usually subsidized by central governments, irrigation costs do not include operation and management, and even less often are the environmental costs of irrigation systems considered. Generally, agricultural water rates do not give a price signal to promote efficiency, nor do they account for the costs of protecting water sources, meaning the range of activities needed to conserve the ecosystems sustaining them. In addition, water rates do not include the environmental impact of the discharge, and agriculture can be a substantial source of water pollution, both as point and nonpoint sources.

Figure 3.1 Components of agricultural water cost.

Prices Must Include Ecological Values

As will be discussed in Chapter 4, there has been an evolution of terms and methodologies of TCA. As global studies have highlighted the value of nature to the global economy, greater interest has been directed towards quantifying these benefits—also known as ecosystem services—and finding ways to monetize them. Several Andean countries began promoting payments to landowners that apply sustainable management practices. Many of these beneficiaries are agricultural producers committed to protecting these landscapes (Daily and Ellison, 2002). All the ecological considerations imply values which the formal economy does not internalize. As the TEEBAgriFood framework discussed in Chapter 4 illustrates, different methods of TCA include different values in order to be more comprehensive. All methods indicate that prices of agricultural water might need to increase, which can be controversial and politically sensitive. Unlike other product prices, water rates for agriculture are not updated regularly, and the legislation does not have mechanisms in place for

evaluation and renewal. For example, in Colombia rates have been litigated against for decades. The only region in the country where agricultural water rates were established—the Cauca River Valley—has also been the region where more innovative management measures have been incorporated. Strong user participation, particularly by farmers, is fundamental to price water effectively and consider additional benefits and costs. Some of the first investments to protect water supplies were established in Latin America and were promoted by farmers aware of the impending water limitations, such as the Water User Associations in Colombia or the Water Producers Program in Brazil.

Colombia: Source Water Protection by Agricultural Users

Colombian sugar cane producers in the Cauca River Valley created an institutional arrangement to value source-water protection. Inspired by French watershed organizations, a local sorghum and soy farmer and former Minister of Agriculture, Jaime Uribe, was worried about the reduced water flow of the Guabas River, owing to upstream deforestation. He invited his neighbors and friends to form a water users association, a legal construct under Colombian law, and ASOGUABAS was born in early 1988. This association brought together farmers with established water rights. Each farmer agreed to pay an additional voluntary fee based on the volume of water allocated in their water rights, which would go to a common fund to support upstream conservation actions. The collected money was managed by the farmers themselves, through an elected board that worked closely with the local water and environmental agency to co-finance and collaborate on activities as part of an integrated watershed management plan.

What began as a focus on purchasing land so that poor upstream farmers would not expand the agricultural frontier, evolved into a more holistic approach towards community organization and development to improve local livelihoods. Colombia has faced social conflict for more than four decades, during which time much of its rural population has migrated to urban areas, furthering the economic and social demise of rural communities in the Andean highlands. The case of ASOGUABAS inspired the creation of eight more associations on surrounding watersheds that involved hundreds of sugar cane and grain farmers and sugar processors in the area.

Currently, there are more than ten associations that work throughout the Cauca river valley. Over time, the association of sugar cane producers (ASOCANA) supported numerous initiatives to improve watershed management and socioeconomic studies and projects to improve local livelihoods. For example, the Association of water users of the Desbaratado River (ASODES) developed a new watershed management plan that involved the active participation of local communities. Rather than focusing solely on maintaining forest cover, the integrated approach taken by ASODES also empowered local stakeholders to be active participants in the planning process. As a result, the association has evolved into a comprehensive watershed management entity that has received various national and international recognitions.

In 2010 The Nature Conservancy proposed to ASOCANA to bring the disparate associations together into a common water fund to create the “Water Fund for Life and Sustainability.” This fund provides financial resources to water user associations that in turn leverage more money from other entities, including multinational companies, foundations, and other donors. CENICANA, the industry’s research center, coordinates hydrological monitoring throughout the Cauca river valley. Therefore, the price of water for sugar cane producers in Colombia includes the protection of its regeneration.

Water Stocks Depend on Ecology

Agriculture uses about 70–80% of water worldwide, and it is now commonly accepted that increased water scarcity is negatively affecting food production. The causes for water shortages are varied, but as human populations grow, there is greater demand for water that is often supplied with little concern for environmental safeguards, thus depleting aquifers, and leading to rivers, lakes, and wetlands drying up. This phenomenon goes largely unperceived and is happening at an alarming rate (Rodell *et al.*, 2018). As global water consumption continues to increase, more aquifers are being depleted, and more water is diverted to urban areas, contributing to a growing irrigation water deficit that impacts arid regions and countries particularly hard. We use water every day but, astoundingly, most of us do not know where our water comes from, although farmers might know better and recognize the rivers, forests, or wetland that sustain their livelihood. The ingrained assumption is that water is renewable and available at all times, especially for food production. Food provision is vital, but its production can put local water sources at risk. This is the case in the northern Andes, a water superpower.

Northern Andean Ecosystems are True Water Factories

Humid Andean grasslands, known locally as *paramos*, run from Venezuela to northern Peru and are also present in some of the mountainous regions of Costa Rica. *Paramos* are veritable water factories owing to their deep soils with high organic content that store and filter water. There is a direct relationship between healthy natural ecosystems and good water flow and quality, particularly evident in these *paramos*. The amount of rainfall and soil moisture that infiltrates to become stream flow is measured as the runoff coefficient, which tends to be at 20–40% in most soils. In *paramo* soils that act like a sponge, this value can go up to 50–70% (Buytaert, 2018). Rainfall is retained by the vegetation and soils and is released slowly over time; therefore, water management decisions in the highlands must ensure the protection of *paramos*. Another important characteristic of this region is an abundance of lakes and shallow wetlands, which also store large amounts of water and release it slowly. These upland wetland areas are vital sources of water for migrating birds and other animals and plants, food production, as well as drinking water and industrial and recreational uses downstream.

Threats to Livelihoods

Agricultural development, urban sprawl, and mining are causing the loss of vegetative cover on upper watersheds, which has a negative impact on rural communities and their landscapes and puts water flow and quality at risk. Traditional rural livelihoods that have been marginalized and threatened by modern development are losing standing, creating a rural underclass of predominantly older women and children who are left behind to eke out a living from a deteriorated environment. Communal decision-making structures common to the Andes come in conflict with institutional and legal frameworks. Ancestral water management technologies, such as water harvesting, agricultural terracing, or recharge ditches, are being left unused, leading to further water and soil loss. To increase yields, new fields are cleared for cattle and crop production, often draining wetlands, which in turn affects the viability of soils and water for future use.

Current global and regional uncertainties like rising temperatures and erratic and more intense climatic events further affect the sources of water for local communities and food production, competing with downstream demands of urban users and other agricultural producers. McDonald and Shemie (2014) found that the largest 25 cities in Latin America—a total of more than 100 million people—relied on drinking water from landscapes that are more than 40% forests, 30% cropland, and 20% native grasslands and pastures. So, it is clear that food production is a key component of the water protection discussion.

Peru: Water Has Cultural and Spiritual Values

Water is considered a living being as well as a necessity for Quechua communities in the Peruvian Andes, so its management and protection are a top priority. Farming families in Ayacucho grow native crops and raise domestic animals, principally alpacas, in arid areas above 3,500 m elevation. They were severely impacted by regional violence in the 1980s and 1990s, which seriously affected their cultural identity. These families are undergoing a process to recover their identity that has led them to reassess their traditional knowledge and apply it to improve their living conditions (Romero, 2012). Farming families in the Quispillacta region, for example, receive assistance from local professionals of the Aripaylla Bartolomé Association (ABA) who understand and identify with the daily problems and needs of families in the area. ABA's primary focus over the past 20 years has been to ensure access to clean water for domestic use, crop irrigation, and the conservation of communal pastures. Ancestral practices that have been passed on through generations and are still being used have helped these communities to maintain a water supply throughout the year (Ochoa-Tocachi and Buytaert, 2020).

In the local world view, water, soil, and other components of nature are considered to have life. Through ceremonial songs, it is necessary to “call”,

“store” and “carry” to receive water (Romero, 2012). The planting and harvesting of rainwater consist of the following ancestral activities:

- Rainwater storage in small lakes or water holes is surrounded by embankments built of stone and clay. This activity is ceremonial and is carried out with deep respect for the deities of the place where the water holes will be built. The objective is to plant water so that it infiltrates through the soil and feeds the aquifers that give rise to springs and the wetlands of the Andean *puna* (high-elevation dry grassland).
- Source water protection and conservation of riparian zones and other strategic sites are on the upper watershed.
- Sowing specific plants near water holes and wetlands that “call water” or are “mothers of water.” Water holes and wetlands are “bred” with plants that in turn “raise water” as their presence promotes the appearance of water in new places and increases the volume of water in springs. They are protected from domestic animals with stone barriers.
- Wetland restoration and protection through activities that promote the formation and expansion of wetlands in Andean *puna* and the maintenance of water holes and the underground connections among them.
- Festive maintenance of water holes. The use and care of water is linked to ceremonial rituals celebrated between May and September. It is also linked to a high level of community organization, led by young people and children, who are responsible for the festivities and cleaning of the water holes.

The recovery of these water conservation activities has been carried out with the support of ABA and other non-governmental organizations and local government authorities, specifically decentralized water and sanitation agencies. It was necessary to revive such activities, as farmers had begun to forget them owing to their reliance on piped water and the abandonment of traditional practices.

Most of Peru’s coastal and mountainous regions are extremely dry and water is critical during many months of the year. A national law (2015) designed to improve water security featuring the Mecanismo para la Retribución de Servicios Ecosistémicos (MERESE)—a mechanism to provide compensation for ecosystem services—was established to recognize the value and promote watershed conservation and management. MERESE works through voluntary agreements that support actions for the conservation, recovery, and sustainable use of natural infrastructure (or “nature-based solutions”) that improves year-round water security for agriculture, industry, and domestic use. In the case of Ayacucho, MERESE activities (e.g., source-water protection, restoration of small lakes for water storage) are underway on the Cachi watershed—the result of agreements reached between the local water company and upstream communities. This renewed interest in traditional practices for water security and other ecosystem services such as agrobiodiversity conservation has re-energized

local participation and the belief in ancestral knowledge transmitted through generations.

Rivers Run Dry

We have emphasized that upstream natural landscapes protect and regenerate source water for a region's water budget, which national water authorities should monitor and regulate. Water authorities should also be gauging the condition of a country's water supply, both in terms of quantity and quality, and comparing this to the needs of the population and the ecosystems that it harbors. Understanding the ecological basis of water supply and demand is an integral part of TCA, and this is beginning to happen in Latin America where instream flow regulations have been instituted in some countries but have been difficult to enforce, owing to poor capacities to manage and evaluate information on water quantity and demand. Notably, Mexico has recognized the value of environmental flows and has innovated to create water reserves that set aside an amount of water that cannot be allocated to any human use (see Water Reserves Program Mexico box below). This is an amount of water that offers protection to a river to ensure its ecological viability and its continuous provision of environmental and social benefits downstream. In contrast, most governments of Andean countries have narrowed their water management focus to investing in gray infrastructure projects to benefit, more often than not, entrenched interests. Rivers tend to be overallocated, and the water rights that are handed out exceed the river's water supply.

Box 3.1 Water Reserves Program Mexico

Water needs go beyond humans and must be considered for sustaining all life on the planet. To that end, the national water agency CONAGUA with World Wildlife Fund Mexico has been working over the past decade to redefine water management in the country by promoting the use of an environmental allocation, or now named "water reserve." This entails setting aside a volume of water in a watershed that cannot be allocated for human use, but is instead dedicated to protecting or restoring river health and ecosystems functions. These functions are now recognized as part of the Sustainable Development Goal (SDG) 6.

Currently, the Mexican Government's National Water Reserves Program (NWRP) protects environmental flows (also referred to in other legal contexts as eFlows) in 300 rivers of the country's 765 water catchments, which represent over 50% of the total runoff in the country. The program began in river basins with little conflict over freshwater resources, making it easier to establish a water reserve to maintain healthy ecological characteristics and build environmental resilience. The NWRP's success has been due to the effective collaboration among government, non-governmental organizations, and academic institutions working towards a common goal: to set aside

water for nature now and to mitigate problems in the future. This innovative approach to water allocation uses science to inform public policy which in turn provides the legal basis for a water management strategy that incorporates ecosystem and biodiversity values within the value of water (SDG 15), which has great potential for replication in Latin America.

Water Management Decisions Should Respect the Watershed

Existing water management frameworks tend to be rigid and prescriptive without the necessary mechanisms for periodic evaluation and accountability, and water allocation might not be equitable or transparent. With limited monitoring capacity, water agencies can allocate water without understanding actual supply or might be lacking the necessary data. Rarely do they consider the hydrological processes supported by natural ecosystems, and sometimes watershed boundaries that demarcate the planning unit fail to be soundly incorporated into the decision-making process. Meanwhile, demand is driven by water user groups that lobby to ensure their own allocation. This sectoral approach limits an understanding of the whole and the impacts that users are likely to cause to each other.

Water management is inherently a collective process. In every watershed there are many stakeholders with distinct water needs; therefore, conflicts must be resolved, and agreements made. New digital and information technologies allow access to large amounts of data needed for water budgeting at a reduced cost. A holistic approach to water budgeting implies understanding supply and demand and their ecological limits and can improve decisions. However, this will succeed only if there is the active participation of users who commit to the application of sustainable water practices. And farmers have to be protagonists in this story, as illustrated by the cases discussed here. In the words of Brian Richter (2014), a global water expert, “To be durable and effective, water plans must be informed by the culture, economics, and varied needs of affected community members, through open, democratic dialogue and local collective action.”

Ecuador: Agricultural Users are Key Players in Water Governance

An illustrative example of agricultural water governance is the El Angel watershed in northern Ecuador, where the concept of a “social watershed” was used (Jaramillo *et al.*, 2020). Water availability for agricultural use is a constant concern for thousands of rural farmers who require water for food security and family income on this watershed that covers about 75,000 hectares in the Andes. Understanding the farmers’ perspective, their continuous interactions with water, and their daily exercise of governance, highlighted its complexity. The water board’s commitment to daily governance stood out, although it was clearly dominated by men, based on an unspoken assumption that women should be

excluded from decision-making related to water and other natural resources. Specifically, the water board was expected to be filled by long-standing male farmers who were knowledgeable about irrigation and water resource regulations and had the expertise to manage a group of agricultural water users. The work of the water board requires a considerable amount of time in meetings, procedures, tours of the premises, and visits to the water authorities, and their time and efforts should be valued in TCA. Other factors that affected water provision and governance, such as irrigation infrastructure, pollution, water theft, and delinquent payments, generated conflict on the social watershed. These issues and the actions taken towards their resolution need to be better understood and included in the cost equation:

- *Poor irrigation infrastructure:* Most field systems, irrigating through gravity or flooding, are highly inefficient and have structural flaws, having been built many decades ago and not updated or improved, having reached the end of their usefulness.
- *Inadequate waste management:* The rural communities and dispersed dwellings on the El Angel watershed have limited coverage of basic services including sewers and solid waste collection, so waste is dumped into canals and ditches, as well as natural waterways, polluting them and creating social conflicts. Irrigation water was polluted by sewage, industrial waste, agricultural waste, and sediments, which had a negative impact on crops, as well as the animals that drink the water.
- *Water theft:* The improper use of irrigation water or water theft was a generalized conflict, with greater occurrence in the dry season. Although laws and regulations established the responsibility to state entities and irrigation organizations, it was difficult to punish offenders, so frequently legal procedures fizzled out.
- *Delinquent payments:* Despite the committed work of leaders, there were delays in farmers' payments for the irrigation service, which limited investment possibilities in vital infrastructure to improve the operation of irrigation systems. Administrative and financial management experience is required to plan and assign costs for emerging actions.

Conclusion

The experiences discussed here are just samples of a long list of cases that illustrate how communities are internalizing environmental and social values within agricultural water management. ASOGUABAS was a pilot case that has evolved to become a trend, and now there is a critical mass of experiences as tracked by the environmental markets information service Ecosystem Marketplace. As reported in the State of Watershed Payments, investments surpassed \$24 billion worldwide in 2016, including public sector and privately led programs. In the Latin America and Caribbean region, investments were \$65.9 million, which is a relatively small amount used to finance a large number of projects (Bennett and Ruef, 2016).

As the debate evolves away from just water scarcity toward the application of the Sustainable Development Goals, there is greater impetus to apply more integrated approaches. In particular, the region has been the testing ground for the evolution and proliferation of the water fund model as a vehicle for collective action, and this is scaling globally (Ziegler *et al*, 2014).

This chapter has illustrated the watershed services that nature provides to agriculture. The incorporation of tangible and intangible values in a TCA framework is a step towards learning to manage the complexity and uncertainty of water management. Incorporating social and environmental considerations to quantify water budgets and pricing is imperative for governments to ensure water security. The process is complex because of the multiplicity of systems that are interconnected, but there are emerging lessons and models for effective collective action, with strong civil society and private sector participation that can drive innovation to scale TCA for the agricultural sector. In the spirit of the development expert Paul Polak (2008), the practical solutions presented here are based on real experiences that respect the local context.

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