

“Putting Suppliers on the Map:” Centering Upstream Voices in Water Funds Outreach

*Kelly Meza Prado¹, Leah L. Bremer^{2,3}, Sara Nelson⁴, Kate A. Brauman^{5,6}, Amalia Morales Vargas⁷, and Rachelle K. Gould⁸

¹The Natural Capital Project, University of Minnesota, St. Paul, MN; ²University of Hawai'i Economic Research Organization, University of Hawai'i at Mānoa, Honolulu, HI; ³Water Resources Research Center, University of Hawai'i at Mānoa, Honolulu, Hawai'i; ⁴School of Public Policy and Global Affairs, University of British Columbia, Vancouver, BC, Canada; ⁵Institute on the Environment, University of Minnesota, St. Paul, MN; ⁶Global Water Security Center, University of Alabama, Tuscaloosa, AL; ⁷Asobolo, Pradera, Valle del Cauca, Colombia; ⁸Rubenstein School of Environment and Natural Resources and Gund Institute for the Environment, University of Vermont; *Corresponding Author

Abstract: As water funds and other watershed investment programs expand around the world, there is growing interest in designing equitable programs that provide both upstream and downstream benefits. While research demonstrates that diverse values underlie upstream participation, existing communication and outreach materials from non-governmental organizations (NGOs), governments, development banks, and others tend to highlight the goals of downstream actors (e.g., improving water supply for cities), with little attention to upstream perspectives. We present a case study in response to this gap, where we collaborated with a water fund and a river users association in Colombia to co-produce a website entitled “Putting Suppliers on the Map” in which interviews and photography illuminate the perspectives of upstream participants and the intermediary organization. The website offers multiple lessons for communication and environmental education in water funds by shifting focus to the motivations of upstream participants, including trust-building among upstream and downstream participants via intermediary actors, and informing downstream water users of the essential role of these processes for program success. Analyzing the website testimonials, we show that the vast majority of participants were motivated not only by overlapping instrumental and relational values associated with conservation, but also by a variety of personal and community goals. We found that the largest barrier to participation over time was the need to build trust between the water fund and rural communities and to align water fund goals with participants' motivations. By making visible the motivations and challenges of upstream actors, the website reverses the standard direction of environmental education (in which high-level actors or downstream groups educate upstream residents). In-so-doing, the website aims to help downstream actors envision more productive and equitable ways of interacting with upstream participants.

Keywords: *watershed protection, payments for ecosystem services, co-production, equity*

Water funds are a type of watershed investment program—also referred to as Payments for Ecosystem Services (PES) or Payments for Watershed Services (PWS)—that are becoming more common worldwide (Bennett and Ruef 2016; Salzman et al. 2018). In these programs, groups of watershed stakeholders financially support activities to protect and restore upstream watersheds (Goldman-Benner et al. 2012; Brauman et al. 2019). As programs have proliferated, so has interest in better understanding the upstream communities that participate in

program activities (Pascual et al. 2014; Blundo-Canto et al. 2018).

Theoretical understanding of water funds and other watershed investment programs often focuses on financial incentives, conceptualizing programs as primarily economic instruments in which participation is contingent on appropriate payment (Wunder 2005). Research on upstream social outcomes, however, has generally found that non-monetary factors, such as environmental and social values, strongly influence participation (Bremer, Farley, and Lopez-Carr 2014; Arriagada et al.

Research Implications

- Collaborative research focused on creating useful products with local institutions can increase the visibility of upstream water fund participants’ work, knowledge, and values.
- Co-production of communication and outreach materials positions upstream watershed actors as educators, rather than simply as recipients of financial conservation incentives.
- Co-producing water fund outreach and communication materials with upstream participants expands program narratives to better capture upstream perspectives.
- Upstream participants have complex and diverse motivations and strategies for participating that go far beyond financial and material factors.
- Intermediary organizations are fundamental to the success of water fund programs, as their education and outreach activities are central to recruitment, building trust among upstream participants, and implementation of projects.

2018; Bétrisey, Bastiaensen, and Mager 2018). In addition, water fund effectiveness increases when upstream stakeholders feel that programs provide them with equitable benefits (Pascual et al. 2014; Lliso, Pascual, and Engel 2021). These findings about upstream actors’ motivations reveal the importance of better understanding these crucial program participants.

Outreach and educational materials for water funds tend to align with theoretical conceptualizations of watershed investment programs as financial mechanisms, and thus primarily focus on the generation of financial and political support by downstream actors. We reviewed the stated goals and audience of 14 reports from six watershed investment programs, including water funds, that were packaged for the general public (see SI Table 1). All explicitly state their purpose in engaging downstream communities and external investors—for example, “to help water sector stakeholders, policymakers, funders and financiers” (Trémolet and Karres 2020). In contrast, upstream participants are given less attention; only two of the reports we reviewed

included upstream participants in their stated audience, and both of those address only U.S.-based programs.

Though engaging downstream actors in water funds is crucial, outreach and educational materials that obscure the role of upstream participants may influence social and environmental outcomes by leading to program designs that weaken enrollment, reduce upstream satisfaction, and undermine practices that sustain biodiversity (Bayrak and Marafa 2016; Blundo-Canto et al. 2018; Milne et al. 2019). Focusing primarily on downstream actors and motivations also raises important equity concerns around program design and outcomes (Corbera and Pascual 2012; Lliso, Pascual, and Engel 2021). For example, a focus on downstream values can influence: who bears the costs and who benefits from hydrological improvements (distributional equity); whose voices, values, and worldviews are represented in water funds design, decision-making, and research (recognitional equity); and whether it is possible for upstream participants, primarily small farmers and Indigenous communities, to participate in decision-making processes (procedural equity) (McDermott, Mahanty, and Schreckenber 2013). Moreover, efforts to maximize conservation returns on investment for downstream stakeholders may channel payments to wealthy landowners and inadvertently exacerbate existing inequities, with potential impacts on program longevity (Wegner 2016; Loft et al. 2017).

Accordingly, to improve upstream outcomes and enhance program equity and durability, outreach and education materials must be expanded to better capture the motivations, challenges, and strategies of upstream actors and intermediaries. In addition to addressing some of the equity concerns discussed above, such outreach and education materials have the potential to address important “power blind spots” in ecosystem services programs that reduce program equity, including a lack of attention to labor relations in the co-production of ecosystem services (Berbés-Blázquez, González, and Pascual 2016).

We present a research communications project produced in collaboration with a water fund intermediary organization (a river users association) in the Cauca Valley of Colombia. Despite evidence

of the importance of intermediaries in water funds and other watershed investment programs (Pham et al. 2010; Bosselmann and Lund 2013), as with upstream actors, there has been little outreach and educational work highlighting the role of these institutions. In line with emerging trends in environmental education, including an emphasis on practices that engage with the digital world (Ardoin, Bowers, and Gaillard 2020), one of the major goals of this project was to produce an interactive [website](#) (Figure 1) that could serve as an educational tool targeting a range of actors, including international funders and NGOs as well as downstream actors—mainly sugarcane growers and other agricultural water users within the Cauca Valley. The collaborative research approach and product design aligns well with current understandings of environmental education as “a conservation strategy” that creates “synergistic spaces, facilitating opportunities for scientists, decision-makers, community members, and other stakeholders to converge” (Ardoin, Bowers, and Gaillard 2020, p. 1).

We first describe the study site and interview approach to examine upstream motivations for participation, their activities and labor towards the program, and the outcomes they expect. This is followed by an analysis of the web testimonials and the function of the website. We argue that by increasing the visibility of upstream actors’ motivations and challenges, the website facilitates opportunities for downstream actors to envision more productive and equitable ways of interacting with upstream participants.

Methods

Study Site

Our study focuses on the Fundación Fondo Agua por la Vida y la Sostenibilidad (Water Fund for Life and Sustainability Foundation), a water fund located in the Cauca Valley, Colombia that was established by the Colombian Association of Cane Cultivators (Asocaña), The Nature Conservancy, and other partners in 2009 (Bremer et al. 2016; Nelson et al. 2020; Figure 2). The Cauca Valley is Colombia’s main sugarcane-producing region (Pérez, Peña, and Alvarez 2011; Asocaña 2020; Nelson et al. 2020). Sugarcane is water-intensive,

and in 2008 the industry held 64 percent of surface water concessions and 85 percent of groundwater concessions (Pérez, Peña, and Alvarez 2011, p. 157; p. 173). The area has a history of high environmental conflict over the industry’s water consumption, with longstanding accusations of ‘water grabbing’ and displacement by the industry (Vélez Torres 2012; Vélez Torres and Varela 2014).

The importance of irrigation to sugarcane revenues (Asocaña 2011) and the risks posed by social and environmental pressures on the industry’s water supplies have partially motivated its proactive approach to watershed conservation. At the core of the water fund are 15 (at the time of our research) river user associations established and funded by Asocaña starting in the late 1980s (Nelson et al. 2020). The associations collect user fees from water users, including sugarcane growers, sugar mills, ranchers, and other agroindustries. Along with other intermediary organizations, the associations are the “ejecutores en el campo” or on-the-ground implementers who work closely with upstream communities and land managers on activities designed to protect the watershed (see SI Table 2 for activities). The water fund was restructured as a foundation in 2016 (Nelson et al. 2020). The flow of funding for the water fund is illustrated in Figure 3.

Here, we specifically focus on the Agua Clara sub-watershed within the Bolo watershed, where one association, Asobolo, has worked for over 25 years (Figure 2). Over the five years preceding this work, the second author partnered with the water fund and Asobolo to help establish social and hydrologic monitoring, and in doing so built strong research-management relationships (Bremer et al. 2016; Game et al. 2018). The first and third authors have conducted previous research on the historical and social context of the water fund (Nelson et al. 2020).

The Cauca Valley, and the activities of the water fund and associations like Asobolo, have been deeply affected by the conflict between the Colombian government and the Fuerzas Armadas Revolucionarias de Colombia (FARC), which began in the 1960s (Sánchez and Palau Madriñán 2006). The Agua Clara sub-watershed has been considered relatively safe since the water fund started and has thus become a focus for research on

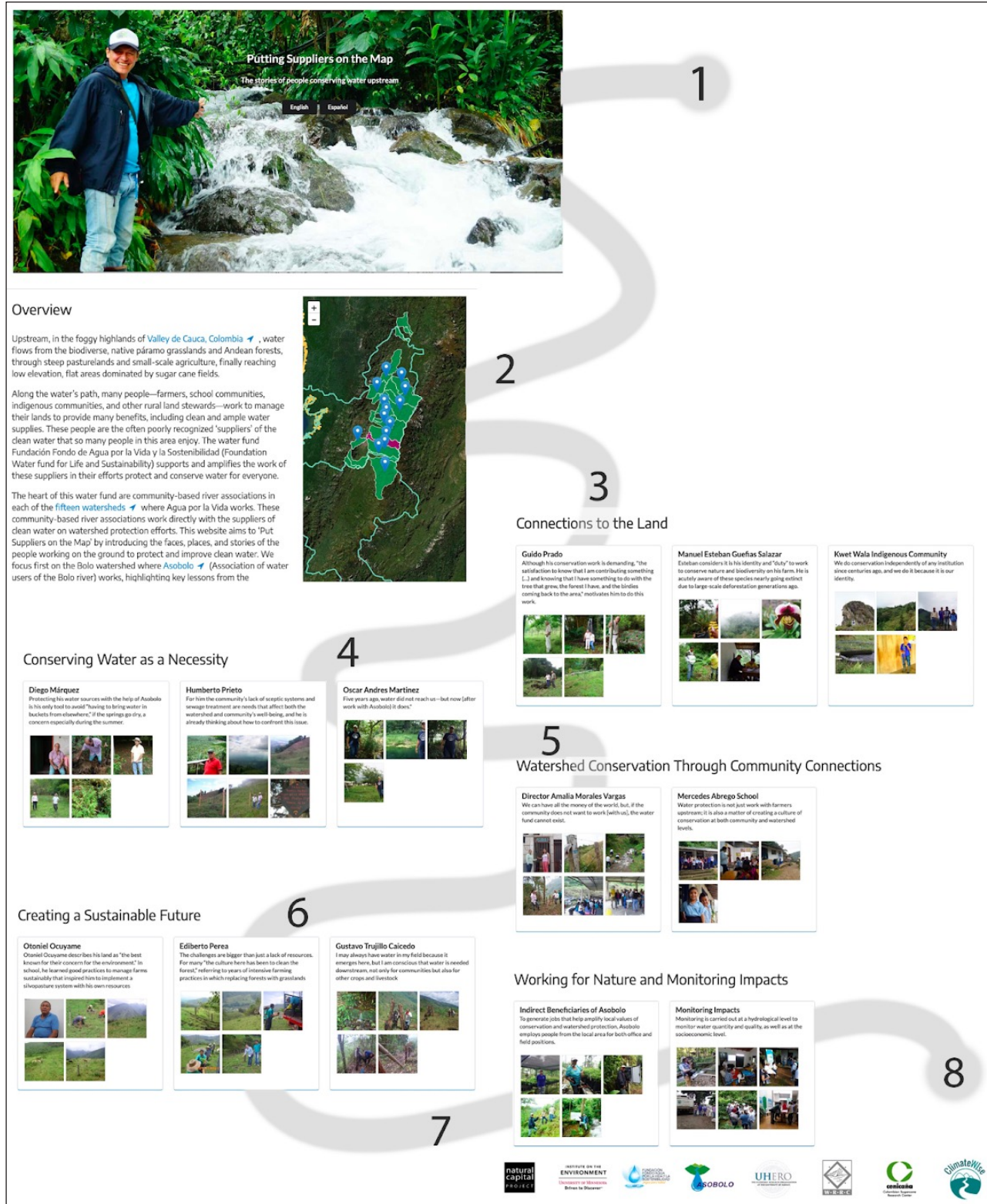


Figure 1. “Putting Suppliers on the Map” website images.

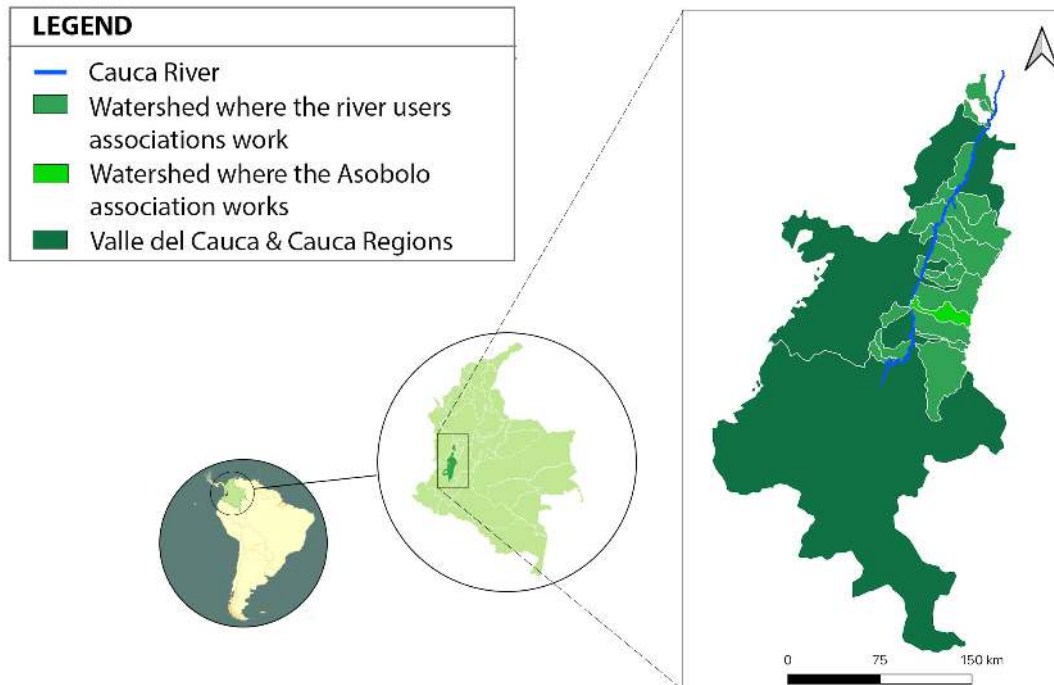


Figure 2. Watershed where the Fundación Fondo Agua por la Vida operates including the Bolo watershed where Asobolo works.

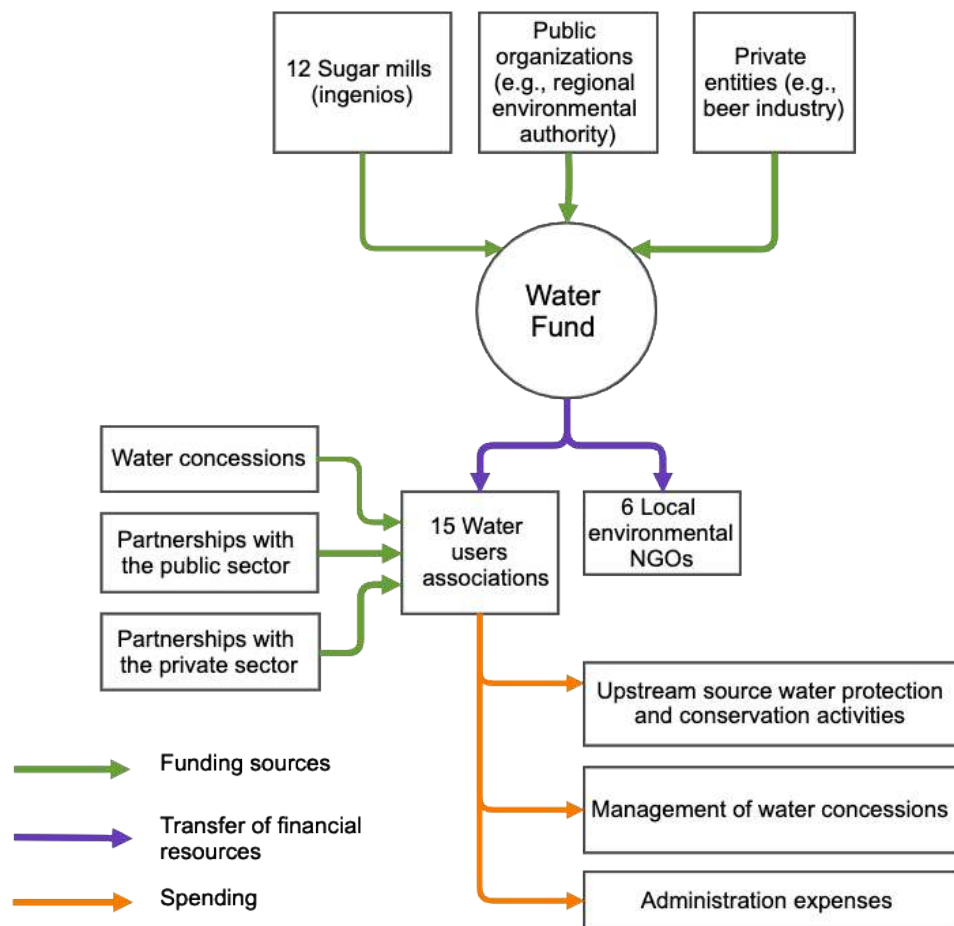


Figure 3. Financial structure of the water fund. Green, purple, and orange arrows represent funding sources, transfer of financial resources, and spending by the associations, respectively.

the social, hydrological, and biodiversity impacts of the water fund (Bremer et al. 2016; Game et al. 2018). Though still considered relatively “safe,” special protocols are followed in the field (e.g., researchers are not allowed out after 4 pm), and the vast majority of people in the region have suffered from violence over the last four decades. Virtually all research contacts have been personally impacted by conflict-related violence. The conflict has shaped conservation trajectories (for instance, reforestation following agricultural displacement) and has heightened the importance of the associations as intermediary organizations. As some of the only organizations working in conflict-affected areas, where development investment by the state was largely absent, the associations have become conduits for resources to support community development goals.

Motivation for this Project

Recent work capturing the distribution of ecosystem service benefits has made important contributions to the incorporation of equity into ecosystem services research (e.g., Mandle et al. 2015; Keeler et al. 2019), but the labor and true costs of co-producing ecosystem services, as well as the values and perspectives that motivate these actions, are generally not included in these analyses (Berbés-Blázquez, González, and Pascual 2016; Zafra-Calvo et al. 2020). Accordingly, the current project, conceptualized as “Putting Suppliers on the Map,” aimed to create outreach and educational material to highlight the upstream activities critical to co-producing the ecosystem services at the heart of water funds.

A website was conceived as the end product of this research, following trends identified in environmental education research indicating that successful outreach material 1) addresses a collective, community-embedded initiative; 2) focuses on social-ecological systems and links between human well-being and environmental quality; and 3) engages with the digital world (Ardoin, Bowers, and Gaillard 2020). Accordingly, the website showcases the work and perspectives of participants to foster greater understanding and stronger connections between upstream and downstream stakeholders. The website thus blurs the lines between education and outreach,

increasing public awareness of the fund while also amplifying participants’ values and knowledge to educate downstream beneficiaries about the social-ecological relations that sustain their water supplies. These efforts fit within Asobolo’s premise that water conservation is the responsibility of the broader community rather than that of water fund participants alone, and it complements the association’s educational activities upstream (e.g., environmental workshops in schools), which emphasize the links between upstream water protection and the well-being of residents.

Although Asobolo has been working in the watershed for over 25 years, it had never publicly communicated its work due to the risks posed by armed conflict in the region and was just starting to develop their online presence. We agreed that the website would be considered a “snapshot in time” that did not need updating due to limited local capacity to sustain online products.

Interviews

To document participant experiences, we combined a semi-structured questionnaire with walking interviews (Drever 1995; Carpiano 2009) conducted around the areas where participants were carrying out conservation activities (e.g., riparian forest stewardship, spring protection, agroforestry, etc.). We chose semi-structured and walking interviews to create open conversations whereby participants could express their perceptions and motivations to participate in the program, and where the landscape might prompt reflections and connections.

In total, we interviewed 10 participants of Asobolo, selected using purposive sampling by farm size (three small: 3.8 to 4 ha; four medium: 10 to 44 ha; three large: 120 to 576 ha). Interviewees included three representatives from one Indigenous community, who were interviewed as a group. Additionally, the director of Asobolo was interviewed. The interviews were arranged by the Asobolo director but were conducted without the presence of Asobolo staff. Interviews focused on three broad themes: 1) motivations to participate in the program, 2) perceived benefits and challenges of participating for themselves, their community, and their surrounding environment, and 3) advice for potential future participants. As participants

generally viewed themselves as participants in Asobolo rather than participants in the water fund, questions focused on their experience with Asobolo.

The website was co-produced with Asobolo, which resulted in much more interaction between researchers and practitioners than would normally occur in conventional research. We met frequently with the association while constructing the website to fact-check, share data (e.g., spatial data), and determine the most effective communication strategy. Though the overall project was collaborative, the researchers analyzed interviews and identified overarching themes that motivated participation independently, with the goal of portraying the interview data as objectively as possible (e.g., not altering findings for the purpose of promoting the program). The researchers and Asobolo then collaborated to create the website.

Interviews were transcribed by the first author and analyzed for emergent themes using a grounded theory approach (Ellis 1993). Representative stories and summaries of interviewees were organized and presented on the website. Once finalized, the website was presented to all participants in a gathering at the Asobolo office.

Results

In this section, we describe the main findings of interviews that are presented on the “Putting Suppliers on the Map” [website](#) (Figure 1). We then describe the use of the website by Asobolo as a communication and education tool.

Asobolo: An Intermediary Organization Creating a “Water Culture”

Our interviews emphasized the important role of Asobolo as an intermediary organization that recruits upstream participants and sustains enrollment through constant field visits and one-on-one relationships. Accordingly, “Putting Suppliers on the Map” begins with an interview with the director of Asobolo, as the main point of contact between upstream participants and the water fund. She states that “*the water funds provide the financial resources and the associations [like Asobolo] provide presence in the field.*”

Beyond direct water funds participants, however, Asobolo has sought to involve the broader

community as much as possible by promoting the idea of a “cultura del agua” (water culture), which emphasizes the impacts of watershed conservation for upstream participants and their communities instead of for downstream beneficiaries. This approach has included partnering with local schools for environmental education workshops; running community-wide social cartography exercises to establish a common vision for the future of the watershed; and supporting community activities that are not necessarily linked to conservation, such as road repair and aiding people in need (SI Table 3). This work has also positioned the association as a trusted organization in the watershed, serving the critical function of building sustainable upstream-downstream social-ecological linkages. Today, Asobolo does little individual recruitment of landowners, as there are now more people who desire to participate than the program can finance.

Diverse Motivations for Participation

Interviews revealed that participants are driven to join the water fund by multiple, overlapping motivations. For the purpose of the website, we identified three broad categories of motivations: 1) connections with the land and desire to care for it, 2) conserving water as a necessity, and 3) creating a sustainable future. Stories and perspectives are organized into one of these categories based on the most salient motivations identified in each interview.

Connections with the land and desire to care for it.

“According to the uses, customs, and cultures that we practice, within the territory we manage the sacred sites that for us are the connection with Mother Earth and the spiritual beings.”
-Kwet Wala Indigenous Community

We included narratives from a small landowner (~4 ha) with off-site income sources, a small farmer (~10 ha), and an Indigenous community (~280 ha). A connection to land and a desire to care for it was common among participants but differing livelihoods and socio-cultural identities shaped how each viewed the benefits from participating in the program.

In the first example, a small landowner did not generate income from the land where restoration

activities took place; he had substantial income from a downstream sugarcane farm and was one of the two highest-income interviewees. The participant explained that growing up in the area and having childhood memories tied to it inspired his decision to return as the armed conflict subsided in the region. His connection to the land inspired a sense of responsibility to care for the river that flows through the property, and he expressed interest in working with riparian forests and buffers but had less interest in (and at times has rejected) activities producing marketable products (e.g., agroforestry). For example, while Asobolo recommended planting riparian trees with four meters spacing to facilitate the use of trees as timber, he explained:

“But I decided to plant them with 3-meters of distance because I have the experience that trees planted within 3-meters of distance are tall and thin. The timber is not commercial. ...But when you plant them at 4-or-5 meters distance, they turn out to be wide and are commercial, and can produce timber. The idea is that 20-or 30-years from now, the forest is grown, not exploitable and that simply is not viable [as a source of timber].”

Implementing restoration activities in a way that reduces the likelihood of riparian trees being cut for timber stemmed from his interest in the long-term ecological benefits of restoration rather than the monetary or production value.

In contrast, a small-scale farmer of Nasa (an Indigenous group) descent, who relied on his land for income, was interested in conservation activities that simultaneously supported watershed conservation and generated income. He explained that he was born and raised in the area and his strong connection to his family’s land led him to stay in the area even as others left during the height of the armed conflict. Much of his farm is on steep slopes, and he worked with Asobolo to establish an agroforestry system that simultaneously reforests his land and provides marketable products such as avocado and lulo (a local fruit). From the perspective of both Asobolo and the participant, agroforestry systems offer more equitable land management options than simple restoration. However, our interview with the participant also revealed his desire for additional incentives to participate

in restoration, such as access to electricity, and his vision of long-term compensation for forest managers rather than project-based funding.

In the final example, representatives from the Kwet Wala Indigenous community, which participates in the program as a communal landowner, described their connection to the land in terms of their homecoming to their territory. This land was only recently returned to them, and the water fund provided necessary resources to manage it in ways that aligned with their cosmovision (belief system) as Indigenous peoples. For example, they explained that *“according to the uses, customs, and cultures that we practice, within the territory we manage the sacred sites that for us are the connection with Mother Earth and the spiritual beings.”*

The type of work the Kwet Wala community chose to engage in with Asobolo was based on their worldview and their own “plan de manejo” (land management plan). Kwet Wala representatives described this as a more holistic view, explaining that *“we do not talk about the forest or water [only]; we talk about nature.”* They considered conserving their land to be a connection with their heritage and ancestors and characterized themselves as natural caretakers of the land. In addition, Kwet Wala representatives described their participation in conservation programs such as Asobolo as a strategic tool to make their identity as Indigenous peoples and conservationists recognized and valued by local authorities.

“When we do these types of exercises [this interview] we tell the community why it is important to get out to talk with the CVC [environmental authority], and with Asobolo, and with Asofrayle [another association], and with the environmental authorities. It’s because we try to be included, to be recognized, that we are here, and that our position is of environmental conservation, because we are environmentalists, and that by being there they are obliged to recognize us.”

They emphasized that a relationship built with Asobolo was built on mutual agreement to follow that community’s autonomous conservation goals; however, they emphasized that *“we will continue conservation because we are not only those who are here, but the entire Indigenous community,*

in general, that is committed to conservation regardless of whether Asobolo or another institution wants to support.”

Highlighting the role of connection to the land for water fund participants is a critical educational role that websites like “Putting Suppliers on the Map” can play. Without this understanding, water funds may design or fund incentives that are not equitable or of interest to participants, as with the first landowner’s disinterest in agroforestry programs, or that even have negative consequences for participants, for example a project that conflicted with the Kwet Wala “*plan de manejo.*”

Conserving water as a necessity.

“Water is more valuable to me than [the cost of] removing a piece of land from the farm. I don’t mind fencing it [a water springs] off, but I care more about water because even water adds value to the property. It [the ranch] has great value because it has water.” -Small farmer

Interviewees expressed deep concern about decreasing water flows, especially during the summers. These concerns were articulated in testimonies from a small farmer (~3 ha), a medium-sized farmer (~44 ha), and a cattle rancher (~11 ha). Each spoke of water insecurity, including the impact of decreased water availability on land value, as an important motivation to participate.

First, a small farmer chose to fence and protect almost one hectare of his three-and-a-half hectare farm for water protection. This participant, like several others, was not connected to municipal piped water and relied on springs for agricultural and domestic water supply. The threat of dry springs during the summer was a constant concern, and he felt that working with Asobolo was his only tool to avoid “*having to bring water in buckets from elsewhere.*” Concerns about water supply may stem, in part, from the outreach efforts of Asobolo, but participants, including this small farmer, described observations of the specific hydrological changes on their own lands (e.g., good water flow during the summers) as an ongoing motivation to participate.

Second, a medium-sized farmer emphasized both the importance of protecting water and productive activities for economic and food security. This farmer worked with Asobolo to implement a

silvopasture system and protect the two springs on his farm. He was also the representative of the *El Edén* aqueduct that delivers water to farms in his area. In this position, he worked with Asobolo and other environmental organizations to protect the stream that feeds the aqueduct and to advocate for resources for families in the area, who were impacted by the armed conflict. Before work with Asobolo, the farmer led efforts to obtain resources to fence off two kilometers of the streams that feed the aqueduct. With Asobolo, he has continued this work and together they have initiated development projects for the families in the area.

Even when participants felt that joining the program benefited water along with their land, they were aware of the costs and tradeoffs of participation and associated equity and justice implications. This was illustrated by the third example, a rancher, who acknowledged the water benefits of working with the program but also emphasized having to confront costs in the form of labor and resources. Asobolo supported landowners with initial materials to fence off water sources, grow riparian forests and green corridors, and implement agroforestry and silvopasture systems. However, participants were then responsible for maintenance and replacement costs. Although maintenance and ceding land for water conservation is a costly activity, many, including this rancher, saw this as a good trade-off:

“I do not see it [fencing water springs] as losing a piece of the farm, but rather as adding value to the farm. Like I said, cattle used to roam here [around springs], but what does that give me? A little bit of grass, which at the end...Now, as I was saying, I have fewer cows in less space, and I have water.”

Like this rancher, other participants highlighted that land without water has no value and that working with Asobolo to ensure water flow was a critical element in securing the value of their land. At the same time, these participants were aware of their role in watershed conservation and the costs that this work implies in terms of land, time, and paying for materials (e.g., fences, seedlings, etc.). They pointed to the inequities related to the distributions of costs associated with upstream conservation.

Creating a sustainable future.

“Implementing all of this is arduous but rewarding—not only in economic terms, but also in terms of what I contribute to humanity.” -Large farmer

The economic benefits of restoration activities that shift conventional farming and ranching operations to more sustainable practices such as agroforestry provide additional motivation to participate in the program. We highlighted three participants from two large (~120 and 576 ha) and one medium size farm (~12 ha) who articulated “*creating a sustainable future*” as a key motivation for participation. These farmers spoke of the negative impacts of conventional farming for the business itself and the environment.

Referring to years of deforestation for grazing and agriculture in the area, one of these farmers stated that “*the culture here has been to clean the forest,*” which he said reduced shade for livestock, leaving them more prone to heat stress, and left birds without trees to rest on. For this group of participants, economic benefits—articulated as long-term farm sustainability, not in direct monetary terms—were central to their participation. In particular, large farmers reported four economic benefits from activities with Asobolo. First, activities were seen to increase vegetation cover and soil retention, especially in high-slope farms, which helped to keep fertilizers on the ground, thereby reducing input costs. Second, practices such as silvopasture were seen to increase shade and protect livestock from heat stress, which compromised nutrition and reproduction, and which participants perceived to have intensified due to climate change. Third, silvopasture and agroforestry practices that included marketable products such as wood, avocado, or fruits, were valued as an extra source of income. Fourth, for farms that had springs or rivers flowing through their property, protecting these resources was seen as a way of protecting water independence and key to securing the value of land.

Though these three landowners highlighted the economic benefits of restoration practices, they also discussed additional motivations. Some indicated the desire to be viewed as more sustainable. One participant spoke about the “*identity*” of his farm as one of “*the best conserved*

in the area and characterized by our concern for the environment,” which the participant linked to conservation practices on his land, including silvopasture, riparian forests, and spring protection. Participants also emphasized the benefits of their on-farm sustainable practices for the broader local environment. Planting trees through practices such as silvopasture, agroforestry, and living fences, especially when using native species, was understood to provide ecological corridors that helped local biodiversity. Common sightings of local birds and mammals such as deer, coatis, and armadillos were interpreted as a sign that these animals were “*coming back to the area*” and this was perceived to be a direct consequence of sustainability efforts on these farms. Bequest values—the desire to care for the environment for future generations—were also articulated as an additional motivation for participating in the program, albeit to a lesser extent. Another one of the large farmers who implemented silvopasture and riparian forest practices articulated his motivation to participate as serving the common good: “*Implementing all of this is arduous but rewarding—not only in economic terms, but also in terms of what I contribute to humanity.*”

The website highlights that concerns about sustainability are present among water fund participants, a long-term perspective that downstream actors need to understand and support for the water fund to operate effectively.

Discussion

A link to the “Putting Suppliers on the Map” [website](#) is currently featured on Asobolo’s webpage (Figure 1). It is an important part of their strategy to communicate with those beyond the communities with whom they work, from academics to potential funders. Interested parties are directed to that website as a place to start learning about Asobolo and upstream participants.

The goal of creating a website fundamentally impacted the way participants engaged with our interviews. Participants knew from the outset that interviews would be translated into a website to teach viewers about their conservation work with Asobolo. Thus, they often approached the interviews as “*educators,*” with the goal

of demonstrating and explaining their work to others in ways that conveyed both successes and challenges. One explicit goal was to take pictures of the areas that they wanted others to see; these are displayed on the website. This also gave participants the opportunity to choose how they wanted to be portrayed; for instance, one of the interviewees from the Indigenous community chose to wear a traditional vest, as he explained, “*to look more Indigenous.*” In this way, participants were elicited as experts on their own land and work, and encouraged to answer questions with the aim of teaching others about their experience and expertise.

The website highlights participants’ diverse motivations and challenges, which are rarely included in water fund communication materials, and by extension, high-level water fund planning, in an in-depth way. In addition, the website helps those downstream, as well as water fund designers, envision more equitable and productive ways of interacting with upstream actors. Many participants emphasized the ways people downstream benefit from their conservation efforts and, thus, ought to contribute to protect the watershed from both a practical and a just perspective. For example, when asked if he would recommend others joining the program, one farmer explained, “*I would recommend it as long as there are economic benefits. Because it is not fair...I say to ‘La Buitrera’ (downstream municipality): you take and sell the water, and what? If we are the ones taking care of the watershed, we are the ones concerned.*” The sense that his work is going unrecognized even when it benefited him too has shaped his work with Asobolo, which focuses on development projects for the community as much as watershed conservation. As he explains, “*I do believe that it’s important to make people aware of the importance of conservation and water management, but to also help them do this management with resources.*” These concerns raise the need to advance procedural equity in water funds by bringing people to the table to inform how the water fund can better support the goals of participants and diverse notions of sustainability and equity. We suggest that co-produced communication and outreach materials that give voice to ecosystem service “suppliers” are a critical first step toward

more equitable, and therefore more effective, water fund design, compensation structure, and spatial targeting.

Water funds could be considered a form of environmental learning initiative given that two primary aims are to increase awareness of environmental processes and increase pro-environmental behavior. Thus, when considering the educational dimension of water funds, the website also aligns with calls from environmental education scholars to foreground people’s emotional reactions to environmental learning initiatives (Russell and Oakley 2016) and to understand environmental movements within “the contexts in which people live and work” (Ardoin, Bowers, and Gaillard 2020, p. 501) (Table 1). By showcasing upstream participants’ perspectives in a public forum, the website increases visibility and understanding of how conservation practice is embedded in people’s lives and shaped by their broader values.

The focus of most outreach materials (see Appendix A) on downstream interests tends to simplify the portrayal of upstream participants. Rather than straightforward stories of upstream land managers motivated by economic incentives, participants we interviewed expressed complex agency and strategic use of the water fund/Asobolo. Value recognition is important to equity in environmental programs (McDermott, Mahanty, and Schreckenber 2013), and the website makes this possible. The Kwet Wala community, for instance, deliberately chose to engage with the website as an educational tool because they perceived the need to educate environmental authorities and relevant organizations about their land management strategies.

We also find that trust (or lack of trust) is a key component of willingness to participate, and is largely mediated by associations like Asobolo, yet the central role of intermediaries is rarely communicated in water fund outreach material. The website begins with a focus on Asobolo and insights from an interview with the director because, like other intermediaries, Asobolo has developed strategies to gain and maintain the trust and support of participants and their communities. Broader understanding of this needs to be more central in communication, outreach, and equitable PWS design.

Table 1. Alignment between this project and environmental education principles.

| Principle of or trend in environmental education | How the project described here aligns with principle |
|--|---|
| Emphasize contextual knowledge, expertise, and practices (Ardoin, Bowers, and Gaillard 2020) | Highlights upstream actors’ rich place-based knowledge |
| Address collective learning (Wals 2007) | Allows upstream actors to educate other actors about their roles |
| Focus on social-ecological systems (Stevenson et al. 2014) | Stories portray integrated social-ecological systems and support these systems by increasing understanding of upstream knowledge and values |
| Encourage active civic engagement (Stevenson et al. 2014) | Increases recognition of upstream actors’ crucial roles in the operation and success of water funds and their associated social endeavors |

Targeting efforts and program design need to consider power relations, political context, and social goals, alongside hydrologic ecosystem service goals, to avoid marginalizing the values of those living in the watershed at the expense of (often higher income and more powerful) downstream interests (Nelson et al. 2020). Using novel educational tools such as websites to highlight the goals and values of communities, individual landholders and intermediary organizations can help produce more equitable and effective watershed investment programs.

Conclusion

Environmental education is increasingly conceptualized as a reciprocal and participatory process, so there is a critical need to expand the range of outreach and communication materials on water funds and other types of watershed investment programs. Through the “Putting Suppliers on the Map” website, we make one of the first attempts to represent the voices of upstream participants in an outreach product. Centering them as educators and communicators, we highlight the role of upstream participants in co-producing the ecosystem services that water funds are designed to protect and enhance. We hope that the website and similar materials can facilitate outreach and communication strategies that align with visions of environmental education as the creation of “synergistic spaces, facilitating

opportunities for scientists, decision-makers, community members, and other stakeholders to converge” (Ardoin, Bowers, and Gaillard 2020, p. 1). Understanding the perspective of upstream participants is essential for water funds to support the recognition and ‘re-valuing’ of rural spaces and livelihoods (Shapiro-Garza 2013). Most importantly, understanding upstream perspectives and integrating them into water programming is key to advance linked equity and conservation goals.

Acknowledgements

We are deeply grateful to the interviewees and Asobolo staff who gave their time and perspective to co-create this website. We also thank Pedro Moreno Padilla, Baudelino Rivera, and Fanny Hoyos for their guidance in site visits and help understanding the operations of the water fund. Karl Bloedorn assisted with website design and programming. Mary Ruckelshaus, Gretchen Daily, and Charlotte Weil participated in the ideation of this project at the Natural Capital Project Olympics 2016. We are grateful to Bonnie Keeler, then director of the Natural Capital Project - Minnesota, for contributing with in-kind resources to develop this project. This research was supported by the University of Minnesota Mini Grant program and the Belmont Forum project ClimateWise (NSF: 16244329). We also thank the University of Hawai‘i Water Resources Research Center for covering publication fees of this manuscript. This is University of Hawai‘i Water Resources Research Center publication # CP-2022-04.

Author Bio and Contact Information

KELLY A. MEZA PRADO (corresponding author) is a Masters student of Public Health at the London School of Hygiene and Tropical Medicine, University of London, UK, where she focuses on the relationships between environment and public health with a focus on clean water provision and equity. Previously, Kelly was a researcher in the Science, Technology, and Environmental Policy area at the Humphrey School of Public Affairs and the Natural Capital Project, University of Minnesota, USA. She may be contacted at mezapradol@gmail.com.

LEAH L. BREMER is an Associate Specialist of Environment Science and Policy at the University of Hawai'i Economic Research Organization and the Water Resources Research Center at the University of Hawai'i at Mānoa, Hawai'i. She has worked extensively on efforts to improve and understand the social and ecological outcomes of PES and water funds in Latin America. Her interests currently focus on co-produced research around sustainable water and watershed management and biocultural restoration approaches in Hawai'i and more broadly. She may be contacted at lbremer@hawaii.edu.

SARA H. NELSON is a Simons Postdoctoral Fellow at the School of Public Policy and Global Affairs, University of British Columbia, Canada, and a Fellow with the Intergovernmental Platform on Biodiversity and Ecosystem Services. Her research focuses on the political economy of environmental conservation and the history and politics of environmental valuation. She may be contacted at sara.nelson@ubc.ca.

KATE A. BRAUMAN kbrauman@umn.edu is the Lead Scientist for the Global Water Initiative at the Institute on the Environment (IonE), University of Minnesota, USA. She also leads IonE's impact goal on achieving safe water and is a Coordinating Lead Author for the Global Assessment of the Intergovernmental Platform on Biodiversity and Ecosystem Services. Her research includes developing improved indicators of water scarcity, assessing hydrologic ecosystem services, and evaluating trade-offs among the ways we use water. She may be contacted at kbrauman@umn.edu.

RACHELLE GOULD is an interdisciplinary scholar whose work involves social science, the humanities, and ecology. She is an Assistant Professor at the University of Vermont. Her research explores the relationship between people and ecosystems and focuses on: 1) Cultural Ecosystem Services and relational values, 2) lifelong and life-wide environmental education and learning, and 3) how issues of equity, inclusion, and

justice permeate environmental issues. She is a Lead Author on the Methodological Assessment of the Multiple Values of Nature, which is part of the United Nations' Intergovernmental Science-Policy Platform on Biodiversity and Ecosystem Services. She may be contacted at rachelle.gould@uvm.edu.

References

- Abell, R., et al. 2017. *Beyond the Source: The Environmental, Economic and Community Benefits of Source Water Protection*. The Nature Conservancy, Arlington, VA, USA. Available at: https://www.nature.org/content/dam/tnc/nature/en/documents/BeyondtheSource_ExecSummary_FINAL.pdf. Accessed October 29, 2021.
- Ardoin, N.M., A.W. Bowers, and E. Gaillard. 2020. Environmental education outcomes for conservation: A systematic review. *Biological Conservation* 241: 108224. Available at: <https://doi.org/10.1016/j.biocon.2019.108224>. Accessed October 28, 2021.
- Arriagada, R., A. Villaseñor, E. Rubiano, D. Cotacachi, and J. Morrison. 2018. Analysing the impacts of PES programmes beyond economic rationale: Perceptions of ecosystem services provision associated to the Mexican case. *Ecosystem Services* 29(A): 116-127. Available at: <https://doi.org/10.1016/j.ecoser.2017.12.007>. Accessed October 28, 2021.
- Asocaña. 2020. *Cultivamos País, Cosechamos Solidaridad: Somos Azúcar y Mucho Más*. Informe Anual: 2020 - 2021. Sector Agroindustrial de la Caña. Available at: <https://www.asocana.org/documentos/2372021-4CF8EC5C-00FF00.000A000.878787.C3C3C3.FF00FF.2D2D2D.A3C4B5.pdf>. Accessed October, 29, 2021.
- Bayrak, M.M. and L.M. Marafa. 2016. Ten years of REDD+: A critical review of the impact of REDD+ on forest-dependent communities. *Sustainability* 8(7): 620. Available at: <https://doi.org/10.3390/su8070620>. Accessed October 29, 2021.
- Bennett, G. and F. Ruef. 2016. *Alliances for Green Infrastructure: State of Watershed Investment 2016*. Forest Trends' Ecosystem Marketplace. Available at: https://www.forest-trends.org/wp-content/uploads/2017/03/doc_5463.pdf. Accessed October 29, 2021.
- Bennett, G., A. Leonardi, and F. Ruef. 2017. *State of European Markets 2017: Watershed Investments*. Forest Trends' Ecosystem Marketplace, Washington, D.C.

- Berbés-Blázquez, M., J.A. González, and U. Pascual. 2016. Towards an ecosystem services approach that addresses social power relations. *Current Opinion in Environmental Sustainability: Sustainability Science* 19: 134-143. Available at: <https://doi.org/10.1016/j.cosust.2016.02.003>. Accessed October 29, 2021.
- Bétrisey, F., J. Bastiaensen, and C. Mager. 2018. Payments for ecosystem services and social justice: Using recognition theories to assess the Bolivian Acuerdos Recíprocos por el Agua. *Geoforum* 92: 134-143. Available at: <https://doi.org/10.1016/j.geoforum.2018.04.001>. Accessed October 29, 2021.
- Blundo-Canto, G., V. Bax, M. Quintero, G.S. Cruz-García, R.A. Groeneveld, and L. Perez-Marulanda. 2018. The different dimensions of livelihood impacts of payments for environmental services (PES) schemes: A systematic review. *Ecological Economics* 149: 160-183. Available at: <https://doi.org/10.1016/j.ecolecon.2018.03.011>. Accessed October 29, 2021.
- Bosselmann, A.S. and J.F. Lund. 2013. Do intermediary institutions promote inclusiveness in PES programs? The case of Costa Rica. *Geoforum* 49: 50-60. Available at: <https://doi.org/10.1016/j.geoforum.2013.05.009>. Accessed October 29, 2021.
- Brauman, K.A., R. Benner, S. Benitez, L. Bremer, and K. Vigerstøl. 2019. Water funds. In: *Green Growth That Works: Natural Capital Policy and Finance Mechanisms from Around the World*, L. Mandle, Z. Ouyang, J.E. Salzman, and G. Daily (Eds.). Island Press, Washington, D.C., pp. 118-140. Available at: https://doi.org/10.5822/978-1-64283-004-0_9. Accessed October 29, 2021.
- Bremer, L.L., D.A. Auerbach, J.H. Goldstein, A.L. Vogl, D. Shemie, T. Kroeger, J.L. Nelson, et al. 2016. One size does not fit all: Natural infrastructure investments within the Latin American Water Funds Partnership. *Ecosystem Services* 17: 217-236. Available at: <https://doi.org/10.1016/j.ecoser.2015.12.006>. Accessed October 29, 2021.
- Bremer, L.L., K.A. Farley, and D. Lopez-Carr. 2014. What factors influence participation in payment for ecosystem services programs? An evaluation of Ecuador’s SocioPáramo program. *Land Use Policy* 36: 122-133. Available at: <https://doi.org/10.1016/j.landusepol.2013.08.002>. Accessed October 29, 2021.
- Calvache, A., S. Benítez, and A. Ramos. 2012. Fondos de Agua: Conservando la Infraestructura Verde. Guía de Diseño, Creación y Operación. Alianza Latinoamericana de Fondos de Agua. The Nature Conservancy, Fundación FEMSA y Banco Interamericano de Desarrollo. Bogotá, Colombia. Available at: <https://www.conservationgateway.org/Documents/LAWFP-ESP-low%20050312.pdf>. Accessed October 29, 2021.
- Carpiano, R.M. 2009. Come take a walk with me: The ‘go-along’ interview as a novel method for studying the implications of place for health and well-being. *Health & Place* 15(1): 263-272. Available at: <https://doi.org/10.1016/j.healthplace.2008.05.003>. Accessed October 29, 2021.
- Corbera, E. and U. Pascual. 2012. Ecosystem services: Heed social goals. *Science* 335(6069): 655-656. Available at: <https://doi.org/10.1126/science.335.6069.655-c>. Accessed October 29, 2021.
- Drever, E. 1995. *Using Semi-Structured Interviews in Small-Scale Research: A Teacher’s Guide*, Scottish Council for Research in Education, Edinburgh, Scotland.
- Edmonds, K., M. DeBonis, and P. Sunderland. 2013. *Forests to Faucets: Protecting Upstream Forests for Clean Water Downstream. A Guide for Etowah River Communities, Water Providers and Forest Landowners*. American Rivers, Forest Guild and Mountain Conservation Trust of Georgia. Available at: https://www.americanrivers.org/wp-content/uploads/2016/05/AmericanRivers_forests-to-faucets-report.pdf. Accessed October 29, 2021.
- Ellis, D. 1993. Modeling the information-seeking patterns of academic researchers: A grounded theory approach. *The Library Quarterly: Information, Community, Policy* 63(4): 469-486. Available at: https://www.jstor.org/stable/4308867?seq=1#metadata_info_tab_contents. Accessed October 29, 2021.
- Game, E.T., L.L. Bremer, A. Calvache, P.H. Moreno, A. Vargas, B. Rivera, and L.M. Rodriguez. 2018. Fuzzy models to inform social and environmental indicator selection for conservation impact monitoring. *Conservation Letters* 11(1): e12338. Available at: <https://doi.org/10.1111/conl.12338>. Accessed October 29, 2021.
- Goldman-Benner, R.L., S. Benitez, T. Boucher, A. Calvache, G. Daily, P. Kareiva, T. Kroeger, and A. Ramos. 2012. Water funds and payments for ecosystem services: Practice learns from theory and theory can learn from practice. *Oryx* 46(1): 55-63. Available at: <https://doi.org/10.1017/S0030605311001050>. Accessed October 29, 2021.

- Hanson, C., J. Talberth, and L. Yonavjak. 2011. *Forests for Water: Exploring Payments for Watershed Services in the U.S. South*. WRI Issue Brief 2. Washington, D.C. Available at: http://pdf.wri.org/forests_for_water.pdf. Accessed October 29, 2021.
- Keeler, B.L., B.J. Dalzell, J.D. Gourevitch, P.L. Hawthorne, K.A. Johnson, and R.R. Noe. 2019. Putting people on the map improves the prioritization of ecosystem services. *Frontiers in Ecology and the Environment* 17(3): 151-156. Available at: <https://doi.org/10.1002/fec.2004>. Accessed October 29, 2021.
- Lliso, B., U. Pascual, and S. Engel. 2021. On the role of social equity in payments for ecosystem services in Latin America: A practitioner perspective. *Ecological Economics* 182: 106928. Available at: <https://doi.org/10.1016/j.ecolecon.2020.106928>. Accessed October 29, 2021.
- Loft, L., T.T. Pham, G.Y. Wong, M. Brockhaus, D.N. Le, J.S. Tjajadi, and C. Luttrell. 2017. Risks to REDD+: Potential pitfalls for policy design and implementation. *Environmental Conservation* 44(1): 44-55. Available at: <https://doi.org/10.1017/S0376892916000412>. Accessed October 29, 2021.
- Mandle, L., H. Tallis, L. Sotomayor, and A.L. Vogl. 2015. Who loses? Tracking ecosystem service redistribution from road development and mitigation in the Peruvian Amazon. *Frontiers in Ecology and the Environment* 13(6): 309-315. Available at: <https://doi.org/10.1890/140337>. Accessed October 29, 2021.
- McDermott, M., S. Mahanty, and K. Schreckenber. 2013. Examining equity: A multidimensional framework for assessing equity in payments for ecosystem services. *Environmental Science & Policy* 33: 416-427. Available at: <https://doi.org/10.1016/j.envsci.2012.10.006>. Accessed October 29, 2021.
- McDonald, R. and D. Shemie. 2014. *Urban Water Blueprint: Mapping Conservation Solutions to the Global Water Challenge*. The Nature Conservancy, Washington, D.C. Available at: https://www.nature.org/content/dam/tnc/nature/en/documents/Urban_Water_Blueprint.pdf. Accessed October 29, 2021.
- Moreno Padilla, P.H. 2017. *Contribución al Manejo Integral de Cuencas Hidrográficas En El Valle Geográfico Alto Del Río Cauca*. Available at: <https://www.asocana.org/documentos/2042017-184FEB1F-00FF00,000A000,878787,C3C3C3,0F0F0F,B4B4B4,FF00FF,FFFFFF,2D2D2D,A3C4B5,D2D2D2.pdf>. Accessed December 1, 2021.
- Milne, S., S. Mahanty, P. To, W. Dressler, P. Kanowski, and M. Thavat. 2019. Learning from ‘actually existing’ REDD+: A synthesis of ethnographic findings. *Conservation and Society* 17(1): 84-95. Available at: <https://www.environmentandsociety.org/mml/learning-actually-existing-redd-synthesis-ethnographic-findings>. Accessed October 29, 2021.
- Nelson, S.H., L.L. Bremer, K. Meza Prado, and K.A. Brauman. 2020. The political life of natural infrastructure: Water funds and alternative histories of payments for ecosystem services in Valle Del Cauca, Colombia. *Development and Change* 51(1): 26-50. Available at: <https://doi.org/10.1111/dech.12544>. Accessed October 29, 2021.
- Ozment, S., R. Feltran-Barbieri, P. Hamel, E. Gray, J.B. Ribeiro, S.R. Barrêto, et al. 2018. *Natural Infrastructure in São Paulo's Water System*. World Resources Institute, Washington, D.C. Available at: <https://www.wri.org/research/natural-infrastructure-sao-paulos-water-system>. Accessed October 29, 2021.
- Ozment, S., T. Gartner, H. Huber-Stearns, K. DiFrancesco, N. Lichten, and S. Tognetti. 2016. *Protecting Drinking Water at the Source: Lessons from Watershed Investment Programs in the United States*. World Resources Institute, Washington, D.C. Available at: https://files.wri.org/d8/s3fs-public/Protecting_Drinking_Water_at_the_Source.pdf. Accessed October 29, 2021.
- Pascual, U., J. Phelps, E. Garmendia, K. Brown, E. Corbera, A. Martin, E. Gomez-Baggethun, and R. Muradian. 2014. Social equity matters in payments for ecosystem services. *BioScience* 64(11): 1027-1036. Available at: <https://doi.org/10.1093/biosci/biu146>. Accessed October 29, 2021.
- Pérez, M.A., M.R. Peña, and P. Alvarez. 2011. Agro-industria cañera y uso del agua: Análisis crítico en el contexto de la política de agrocombustibles en Colombia. *Ambiente & Sociedad* 14(2): 153-178. Available at: <https://doi.org/10.1590/S1414-753X2011000200011>. Accessed October 29, 2021.
- Pham, T.T., B.M. Campbell, S. Garnett, H. Aslin, and M.H. Hoang. 2010. Importance and impacts of intermediary boundary organizations in facilitating payment for environmental services in Vietnam. *Environmental Conservation* 37(1): 64-72. Available at: <https://doi.org/10.1017/S037689291000024X>. Accessed October 29, 2021.
- Russell, C. and J. Oakley. 2016. Engaging the emotional dimensions of environmental education. *Canadian Journal of Environmental Education (CJEE)* 21: 13-22. Available at: <https://www.academia>.

- [edu/34583883/Engaging_the_Emotional_Dimensions_of_Environmental_Education](https://doi.org/10.1177/0094582X14547515). Accessed October 29, 2021.
- Salzman, J., G. Bennett, N. Carroll, A. Goldstein, and M. Jenkins. 2018. The global status and trends of payments for ecosystem services. *Nature Sustainability* 1: 136-144. Available at: <https://doi.org/10.1038/s41893-018-0033-0>. Accessed October 29, 2021.
- Sánchez, F. and M. del Mar Palau Madriñán. 2006. Conflict, Decentralisation and Local Governance in Colombia, 1974-2004. Document CEDE 2006-20, Universidad de los Andes. Available at: <https://repositorio.uniandes.edu.co/bitstream/handle/1992/7999/dcede2006-20.pdf?sequence=1&isAllowed=y>. Accessed October 29, 2021.
- Shapiro-Garza, E. 2013. Contesting the market-based nature of Mexico’s national payments for ecosystem services programs: Four sites of articulation and hybridization. *Geoforum* 46: 5-15. Available at: <https://doi.org/10.1016/j.geoforum.2012.11.018>. Accessed October 29, 2021.
- Stevenson, R.B., M. Brody, J. Dillon, and A.E.J. Wals (Eds.). 2014. *International Handbook of Research on Environmental Education*. Routledge.
- Talberth, J., E. Gray, E. Branosky, and T. Gartner. 2012. *Insights from the Field: Forests for Water*. WRI Issue Brief 9, Washington, D.C. Available at: https://files.wri.org/d8/s3fs-public/pdf/insights_from_the_field_forests_for_water.pdf. Accessed October 29, 2021.
- Trémolet, S. and N. Karres. 2020. *Resilient European Cities: Nature-Based Solutions for Clean Water*. The Nature Conservancy, London, United Kingdom. Available at: <https://www.ecologic.eu/17767>. Accessed October 29, 2021.
- United Nations. 2018. Forests and Water: Valuation and Payments for Forest Ecosystem Services. Available at: file:///C:/Users/SIU853541861/Downloads/UNECEFAO_2018_sp-44-forests-water-web.pdf. Accessed October 29, 2021.
- Vélez Torres, I. 2012. Water grabbing in the Cauca Basin: The capitalist exploitation of water and dispossession of Afro-descendant communities. *Water Alternatives* 5(2): 421-449. Available at: <https://dlc.dlib.indiana.edu/dlc/bitstream/handle/10535/7970/Art5-2-14.pdf?sequence=1&isAllowed=y>. Accessed October 29, 2021.
- Vélez Torres, I. and D. Varela. 2014. Between the paternalistic and the neoliberal state: Dispossession and resistance in Afro-descendant communities of the Upper Cauca, Colombia. *Latin American Perspectives* 41(6): 9-26. Available at: <https://doi.org/10.1177/0094582X14547515>. Accessed October 29, 2021.
- Wals, A.E.J. (Ed.). 2007. *Social Learning towards a Sustainable World: Principles, Perspectives, and Praxis*. Wageningen Academic Publishers, The Netherlands.
- Wegner, G.I. 2016. Payments for ecosystem services (PES): A flexible, participatory, and integrated approach for improved conservation and equity outcomes. *Environment, Development and Sustainability* 18: 617-644. Available at: <https://doi.org/10.1007/s10668-015-9673-7>. Accessed October 29, 2021.
- Wunder, S. 2005. Payments for Environmental Services: Some Nuts and Bolts. Center for International Forestry Research Occasional Paper No. 42. Available at: https://www.cifor.org/publications/pdf_files/OccPapers/OP-42.pdf. Accessed October 29, 2021.
- Zafra-Calvo, N., P. Balvanera, U. Pascual, J. Merçon, B. Martín-López, M. van Noordwijk, T.H. Mwampamba, et al. 2020. Plural valuation of nature for equity and sustainability: Insights from the global south. *Global Environmental Change* 63: 102115. Available at: <https://doi.org/10.1016/j.gloenvcha.2020.102115>. Accessed October 29, 2021.
- Zhang, Q. and M.T. Bennett. 2011. *Eco-Compensation for Watershed Services in the People’s Republic of China*. Asian Development Bank, Mandaluyong City, Philippines.
- Zyla, C., et al. 2018. *Water Funds: Field Guide*. The Nature Conservancy, Arlington, VA. Available at: <https://www.nature.org/content/dam/tnc/nature/en/documents/Water-Funds-Field-Guide-2018.pdf>. Accessed October 29, 2021.

Supplementary Data

SI Table 1. Watershed investment reports reviewed.

| Report | Primary Organization | Regional Focus | | | | | Stated Readership | | | Quotes | Full Citation |
|---|---------------------------|----------------|---------------|----|--------|------|-----------------------------|------------|----------|--|--|
| | | Global | Latin America | US | Europe | Asia | Funders (outside Watershed) | Downstream | Upstream | | |
| Alliances for Green Infrastructure: State of Watershed Investment 2016 | Forest Trends | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | The State of Watershed Investment report is offered to a range of audiences including water utility and other government policy makers, engineering and construction firms, public and private investors, and other stakeholders working on access to clean, reliable water supply. | Bennett, G. and F. Ruef. 2016. Alliances for Green Infrastructure: State of Watershed Investment 2016. Forest Trends, Washington, D.C. |
| Natural Infrastructure in São Paulo's Water System | World Resources Institute | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | While many natural infrastructure proponents are already calling for restoration of the Cantareira, the question remains, who will invest? These proponents can use these financial results to build a more investment-ready strategy for the Cantareira System. They can utilize the maps in this report to target the most high-impact areas and use the roadmap to ensure important social and political enabling conditions are in place for their success. Importantly, they must prepare to address the inherent uncertainty in working with natural infrastructure—efficient and wise program design can ensure a return for investors even if improvements to water supply are on the low end of the range estimated in this study. We hope that water managers, political and business leaders, and civil society groups will use it to spark a renewed effort to restore forests in this region, and beyond. | Ozment, S., R. Feltran-Barbieri, P. Hamel, E. Gray, J.B. Ribeiro, S.R. Barrêto, et al. 2018. Natural Infrastructure in São Paulo's Water System. World Resources Institute, Washington, D.C. |
| State of European Watershed Investments | Forest Trends | 0 | 0 | 0 | 1 | 0 | 1 | 1 | 0 | This report seeks to capture the scale and performance of incentives and market-based mechanisms for green infrastructure for water. It includes not only public finance for watershed health, but also local-scale initiatives driven by water users themselves to address shared water challenges. We use the term "watershed investment" in the sense of a long-term investment in an asset, just as a city would "invest" in upgrades to its wastewater treatment plant. | Bennett, G., A. Leonardi, and F. Ruef. 2017. State of European Markets 2017: Watershed Investments. Forest Trends' Ecosystem Marketplace, Washington, D.C. |
| Eco-Compensation for Watershed Services in the People's Republic of China | Asian Development Bank | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | The central and the provincial governments across the People's Republic of China (PRC) have been investing in and seeking new ideas and methods for improving both supply-side and demand-side management of water resources. This has included numerous national, provincial, and local experiments over the past decade in market-based environmental policy tools under the broad heading of "eco-compensation," with this trend culminating in central government uptake wherein the National Development and Reform Commission (NDRC) has been tasked with developing a national eco-compensation ordinance. This paper makes three key recommendations for the design of the Eco-Compensation Ordinance as it relates to water. | Zhang, Q. and M.T. Bennett. 2011. Eco-Compensation for Watershed Services in the People's Republic of China. Asian Development Bank, Mandaluyong City, Philippines. |

SI Table 1 Continued. Watershed investment reports reviewed.

| Report | Primary Organization | Regional Focus | | | | | Stated Readership | | | Quotes | Full Citation |
|--|---------------------------|----------------|---------------|----|--------|------|-----------------------------|------------|----------|--------|--|
| | | Global | Latin America | US | Europe | Asia | Funders (outside Watershed) | Downstream | Upstream | | |
| Insights from the Field: Forests for Water | World Resources Institute | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | Talberth, J., E. Gray, E. Branosky, and T. Gartner. 2012. Insights from the Field: Forests for Water. WRI Issue Brief 9, Washington, D.C. |
| Urban Water Blueprint: Mapping Conservation Solutions to the Global Water Challenge | The Nature Conservancy | 1 | 0 | 0 | 0 | 0 | 0 | 1 | 1 | 0 | McDonald, R. and D. Shemie. 2014. Urban Water Blueprint: Mapping Conservation Solutions to the Global Water Challenge. The Nature Conservancy, Washington, D.C. |
| Protecting Drinking Water at the Source: Lessons from Watershed Investment Programs in the United States | World Resources Institute | 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 0 | Ozment, S., T. Gartner, H. Huber-Stearns, K. DiFrancesco, N. Lichten, and S. Tognetti. 2016. Protecting Drinking Water at the Source: Lessons from Watershed Investment Programs in the United States. World Resources Institute, Washington, D.C. |
| Water Funds: Field Guide | The Nature Conservancy | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | Zyła, C., et al. 2018. Water Funds: Field Guide. The Nature Conservancy, Arlington, VA. |
| Forests and Water: Valuation and Payments for Forest Ecosystem Services | United Nations | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 | United Nations. 2018. Forests and Water: Valuation and Payments for Forest Ecosystem Services. |
| Resilient European Cities: Nature-based Solutions for Clean Water | The Nature Conservancy | 0 | 0 | 0 | 1 | 0 | 1 | 0 | 0 | 0 | Trémolet S. and N. Karras. 2020. Resilient European Cities: Nature-based Solutions for Clean Water. The Nature Conservancy, London, United Kingdom. |

SI Table 1 Continued. Watershed investment reports reviewed.

| Report | Primary Organization | Regional Focus | | | | | Stated Readership | | | Quotes | Full Citation |
|--|---------------------------|----------------|---------------|----|--------|------|-----------------------------|------------|----------|--|--|
| | | Global | Latin America | US | Europe | Asia | Funders (outside Watershed) | Downstream | Upstream | | |
| Beyond the Source: The Environmental, Economic and Community Benefits of Source Water Protection | The Nature Conservancy | 1 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | Beyond the Source seeks to illustrate the value of nature to cities looking to secure water supplies while adding a number of benefits that address global challenges we face. By restoring forests and working with farmers and ranchers to improve their land management practices, we can improve water quality and reduce water treatment costs for four out of five downstream cities serving 1.4 billion people. | Abell, R., et al. 2017. Beyond the Source: The Environmental, Economic and Community Benefits of Source Water Protection. The Nature Conservancy, Arlington, VA, USA. |
| Forests to Faucets: Protecting Upstream Forests for Clean Water Downstream | American Rivers | 0 | 0 | 1 | 0 | 0 | 0 | 1 | 1 | Promote the concept of downstream benefits of upstream forestland conservation and management by educating forest landowners, forest managers, and water users about how they can work together. Provides an introduction for community leaders, including water providers and forest managers, as they seek to protect, manage, and maintain source-water forests. | Edmonds, K., M. DeBonis, and P. Sunderland. 2013. Forests to Faucets: Protecting Upstream Forests for Clean Water Downstream. American Rivers, Forest Guild and Mountain Conservation Trust of Georgia. |
| Fondos de Agua: Conservando la Infraestructura Verde. Guía de Diseño, Creación y Operación | The Nature Conservancy | 0 | 1 | 0 | 0 | 0 | 1 | 1 | 0 | Create financial mechanisms that offer users, in the lower areas of a watershed, the opportunity to become proactively involved in conserving the high and medium altitude zones of the watershed. Although there have been many watershed investment and management efforts, few of them create a direct link with the protected areas and private properties that generate water environmental services. | Calvache, A., S. Benítez, and A. Ramos. 2012. Fondos de Agua: Conservando la Infraestructura Verde. Guía de Diseño, Creación y Operación. Alianza Latinoamericana de Fondos de Agua. The Nature Conservancy, Fundación FEMSA y Banco Interamericano de Desarrollo. Bogotá, Colombia. |
| Forests for Water: Exploring Payments for Watershed Services in the U.S. South | World Resources Institute | 0 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | This issue brief is intended as an introductory resource primarily for entities that depend upon stable supplies of clean freshwater in the southern United States and are looking for cost-effective approaches to sustain this supply. This brief also provides information to southern landowners interested in potential revenue streams generated by conservation and sustainable management of forests. | Hanson, C., J. Talberth, and L. Yonaviak. 2011. Forests for Water: Exploring Payments for Watershed Services in the U.S. South. WRI Issue Brief 2, Washington, D.C. |

SI Table 2. Watershed management tools employed by associations. Adapted from (Moreno Padilla 2017) and interview with Asobolo director.

| Watershed management tools | Description |
|--|---|
| Fencing | Use of wooden pickets plus barbed wire and living fences to fence off riparian and native forests and streams. When using living fences, 400 trees are planted per km. |
| Spring protection | Fencing of water sources and planting trees for water regulation. |
| Agroforestry | Integration of forestry into agriculture and husbandry systems to obtain environmental and economic benefits. Farmers often mix coffee crops with fruit trees, especially avocado, citrics, and lulo. Ranchers employ silvopasture where livestock production is combined with forestry and forage. |
| Passive restoration and natural regeneration | Restoration of degraded land mainly from cattle grazing. The land is fenced off to allow trees and other vegetation to grow naturally. |
| Erosion management | Construction of check dams or other in-stream blockades, wooden barriers complemented with vegetation to slow the flow of water and increase infiltration. |
| Forest enrichment | Expansion of trees in private forests to produce timber in the future. Up to 100 trees per ha are planted. |
| Protected forests (accelerated natural regeneration) | Tree planting in areas formerly used for husbandry where more than 600 timber trees are planted per ha to accelerate regeneration. |
| Forest for domestic use | In these areas, timber trees (1372 per ha) of fast growth (e.g., pine, eucalyptus, cedar) are planted for commerce or domestic use. These areas are usually distant from water springs and streams. |

SI Table 3. Strategies used to promote a “Cultura del agua” (water culture) in Asobolo, a river users association.

| Strategy | Definition | Purpose |
|--|---|---|
| Ecological inventories | Outings with watershed residents, guided by a local biologist, to do ecological inventories of tree species in the forest, medicinal plants, and riverine organisms. | Shape a sense of belonging among residents and connect them with the natural resources of the watershed. Change attitudes and practices that degrade the local environment (e.g., throwing trash in rivers, felling of trees, and letting livestock graze around springs). |
| Social cartography | Workshops with residents of different generations to reconstruct how the ecology of the watershed was in the past, how it looks in the present, and how they would like it to look in the future. | Build environmental awareness and nurture a sense of ownership of the restoration work of the watershed. |
| Nurseries of native trees | Supported watershed residents to start nurseries of native trees that are sold to the association for their restoration activities. | Have a local supply of native trees and fruit trees to use in restoration activities. Position the association as a job provider for local residents. |
| Radio program | “Eco ambiente: para vivir mejor” (Eco environment: to live better) is a show on the local radio hosted by the association. It focuses on the weekly work of the association, special environmental topics (e.g., climate change and importance of trees), hydrological monitoring, and celebration of environmental awareness days. | Share the association’s work, promote awareness of the local natural resources, strengthen a sense of belonging, and change negative habits that degrade the environment. |
| Partnership with local schools | Partnerships with local schools to support their environmental education syllabus. This includes tree planting, painting workshops related to environmental topics, and field trips to forests and rivers to do ecological inventories (see above). | Long-term investment to shape pro-environmental attitudes in children, so they maintain them as adult residents of the watershed and landowners. |
| Workshops for women (Talleres para mujeres) | Gather women through non-environmental activities (e.g., cooking and embroidery) to hold conversations about their role in the community and the local environment, for example, through wood fuel usage, and how to contribute to the environment from home (e.g., cooking oil disposal). | Strengthen gender equity in participation in the program and highlight women’s importance in water use and forest resources, especially related to tree felling for cooking fuel. |
| Supports the community in non-environmental activities | Supports community with their own development projects. For instance, providing meals in <i>mingas</i> —an Indigenous system of communal work to improve aspects of the community, such as repairing roads and bridges. Provides aid to community members in need. | Cement the association as a member of the watershed and its community. Inspire feelings of reciprocity from the community, so they can also support the association’s work. |
| Water quality and quantity monitoring | Partners with landowners along tributaries to install sediment and water flow monitors on their land and to be stewards of them. | Strengthen sense of pride and belonging for the local area. Provide first-hand observations of positive and negative hydrological changes. Show that everyone can help in conservation. |