



MANAGING WATERSHEDS FOR ECOSYSTEM SERVICES IN THE STEEPLAND NEOTROPICS



Managing Watersheds for Ecosystem Services In the Steepland Neotropics

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Conference Organizers

**Jefferson S. Hall, PRORENA, Smithsonian Tropical Research Institute (STRI)
Jacob Slusser and Saskia Santamaria, Environmental Leadership and Training Initiative (ELTI),
Yale University and STRI**

FORAGUA, the Regional Water Fund of Southern Ecuador

Introduction

Water funds are user-funded mechanisms for the financing of watershed conservation, restoration, and management, designed to ensure water quality and enhance water retention through an ecosystems' natural capacity to store water. One of several water funds that operate in Ecuador is the 'Fondo Regional del Agua' (the Regional Water Fund, known by its Spanish acronym FORAGUA).

the world. It is represented by approximately 7,048 species (José, 2001; Lozano, 2002; Mutke and Barthlott 2005).

Around 19% of the area of the Southern Region is under protection (Ministry of Environment, Ecuador, 2013). Two national parks are located in Loja and Zamora Chinchipe provinces. The largest one, Podocarpus National Park, spans over 146,280

hectares of mainly mountain forests and several thousands of hectares of *paramo* (Keating, 2000). This national park is part of UNESCO's Podocarpus-El Condor Biosphere Reserve, which protects and promotes sustainable development of around 1.1 million hectares of Andean tropical forests in southern Ecuador (Barkman et al., 2013). The second national park, Yacuri, has an area of 43,091 hectares. Both protected areas are a source of water supply for surrounding areas. Other protected areas include the 'Reserva Biológica Cerro Plateado' (26,114 hectares) and

the smaller 'Refugio de Vida Silvestre El Zarza' (3,643 hectares) located in Zamora Chinchipe. The 'Reserva Ecológica Arenillas' (17,083 hectares) is located in El Oro (Ministry of the Environment, Ecuador, 2014).

Despite the existence of these conservation areas, around 70% of the Southern Region area is affected by human factors such as deforestation for agriculture and the collection of fuel wood among others (Lozano, 2002). Moreover, the ability of natural ecosystems to provide water services to people in up-and downstream areas has been degraded by the conversion of natural areas to agricultural land. Water quality is considered problematic as there is a high incidence of diseases due to contaminated water

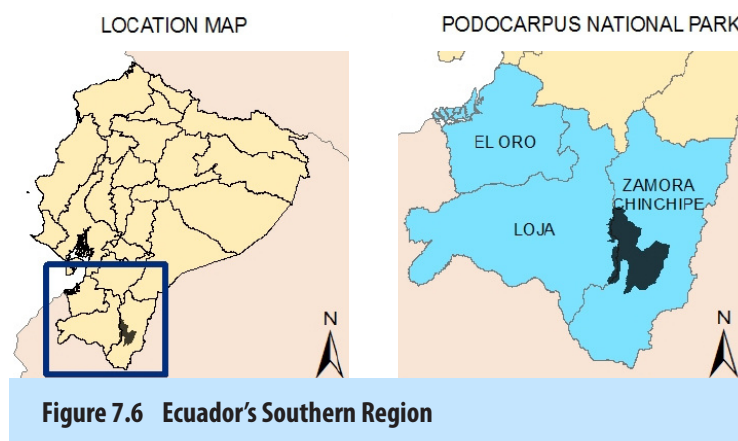


Figure 7.6 Ecuador's Southern Region

FORAGUA is established in the Southern Region of Ecuador which comprises El Oro, Loja and Zamora Chinchipe provinces (Figure 7.6). The region contains areas belonging to the Coast (*Costa*), the Andes (*Sierra*) and the Amazon (*Oriente*). The approximate total area is 27,400 km², which is 11% of the country. The altitude ranges from 0 meters in the coastal areas to around 4,000 meters in the Andean Region. Watersheds in the region can be at altitudes of 400 meters in the municipalities of Pindal and Macará to up to 3,900 meters in the municipality of Loja.

Southern Ecuador is known to be one of the most biologically diverse places in the Andes and Amazonian regions and is among the richest and most diverse in

(Gordillo, 2013). Livestock production and pesticide use are seen as the main causes. Cow manure can be a source of bacteria, while pesticides used for production of crops, such as corn, are often toxic (Webber, 2009). The clearing of forests to create pastures could contribute to erosion and consequently deliver excess sediment to the water. Furthermore, in Southern Ecuador many cities are experiencing a hydrological deficit (Dorado et al., 2011). Most municipalities suffer from a shortage in water supply which is exacerbated during the dry season.

FORAGUA was implemented mainly to improve the provision of hydrological services. According to Farley et al. (2011), the water funds in Ecuador only have limited information available linking land use with production of ecosystem services. However, although the key hydrological services targeted - water regulation and nutrient and sediment retention - are based on the assumed relationship between forests and hydrological service provision (rather than actual measurements), existing research suggests that mountain forests and Andean grasslands (*paramos*) provide hydrological services, the most important of which are water quality through sediment retention (Brauman et al., 2007; Célleri and Feyen, 2009) and regulation of water flow (Bruijnzeel, 2004; Roa-Garcia et al., 2011). Biodiversity conservation is also important as the Southern Andean region of Ecuador is a hot spot for biodiversity (Keese et al., 2007).

tion of ecosystem services and biodiversity of fragile and threatened ecosystems in the provinces of Southern Ecuador (Loja, El Oro and Zamora Chinchipe). FORAGUA is a joint public and private trust, valid for 80 years. It is administered by the 'Corporación Financiera Nacional' (National Financial Corporation, known by its Spanish acronym CFN) and implemented by the constituent municipalities.

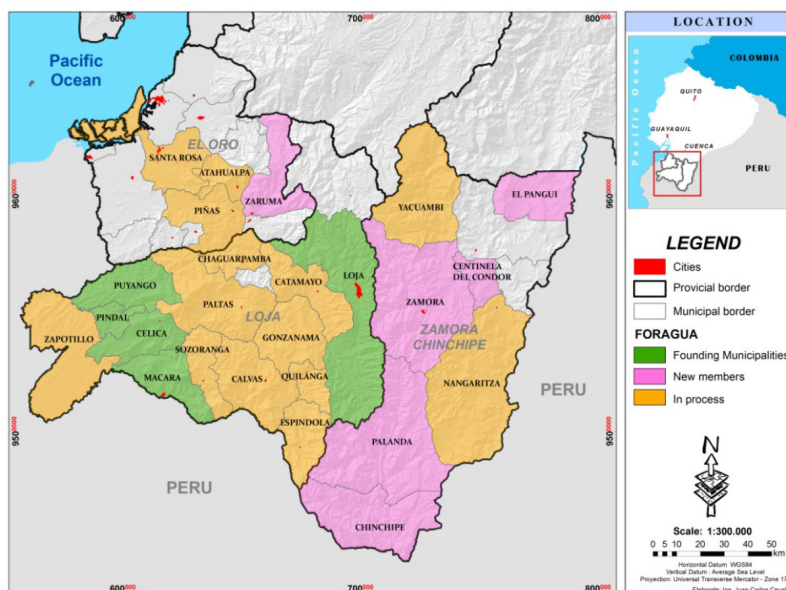


Figure 7.7 FORAGUA's Constituent Municipalities

Currently 11 municipalities are part of the trust, but the goal is to integrate all 39 municipalities of the Southern Region (Figure 7.7). The 11 municipalities have declared approximately 47,798 hectares as reserves, of which around 18,000 hectares is designated specifically for the conservation of water sources for human consumption (see Table 7.2). Over 300,000 people are beneficiaries, about a third of the total population of the Southern Region.

The Water Fund

To halt the degradation of watersheds, in 2009 the municipal governments of Loja, Celica, Macará, Puyango, and Pindal with the support of the NGO Nature and Culture International founded FORAGUA for the conservation, protection and restora-

Watershed Governance

Water governance is enshrined in the Ecuadorian constitution. Article 411 states that "the State shall ensure the conservation, restoration and integrated management of water resources ... Any activity that may affect water quality and quantity, and an

Constituent municipalities as of June 2013	Year	Number of Watersheds	Name of the watersheds	Area of the watersheds (has)	% Conserved
Loja	2009	6	El Carmen, San Simón, Jipiro, Pizarros, Puritroje y Shucos	4,220	95%
Celica	2009	3	Quira, Matalanga y Quillusara	690	25%
Puyango	2009	1	Luz de America	128	21%
Pindal	2009	1	Papalango	884	6%
Macará	2009	2	Mataderos y Jurupe	3,037	11%
Zamora	2011	1	El Limón	1,019	21%
Chinchiipe	2011	2	Los Rubies y Chaupe	8,000	80%
Palanda	2012	2	SUHI, Los Molinos	1,698	-
El Pangui	2012	1	Cayamatza	2,669	-
Centinela Del Condor	2012	1	Zumbi	666	-
Zaruma	2012	2	Guando-Mirmir	1,285	-
Total		22		17,978	

ecosystem's balance, especially in springs and water recharge areas shall be regulated." For the purpose of planning and managing water resources for human consumption the national government created the 'Secretaría Nacional del Agua' (National Water Secretariat, known by its Spanish acronym SENA-GUA). Additionally, Article 264 of the constitution and Article 55 of the Code of Zoning, Autonomy and Decentralization state that it is the authority of the Municipal Decentralized Autonomous Governments to exercise control over land use within its territory. Municipal authorities thus have the power to zone their own territories and manage their watersheds. Article 137 mentions that "the responsibility for the provision of public drinking water in all its phases shall be implemented by the Municipal Decentralized Autonomous Governments."

The Regional Water Fund itself is based on the creation of municipal ordinances for the declaration of watershed reserves, the protection and restoration of degraded ecosystems and the creation of a charge for hydrological services in each municipality. The implementation of municipal ordinances establishes the authority to declare municipal reserves, in accordance with the Ministry of Environment (Figure 7.8).

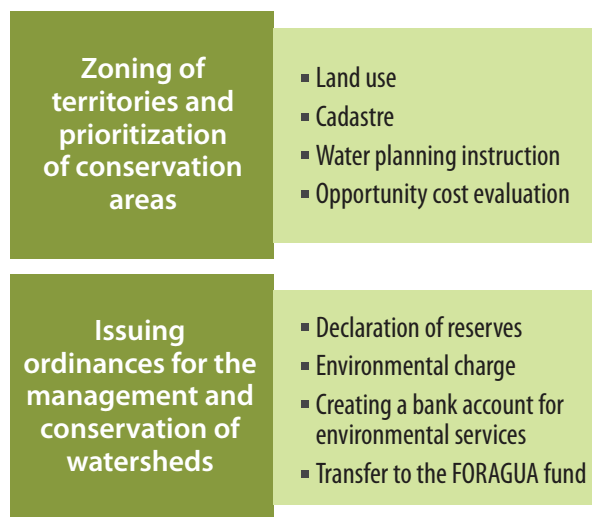


Figure 7.8 Synthesis of Legal and Zoning Procedures of Municipalities

The declaration of land as a municipal reserve limits the use of natural resources in the affected properties. Although the main focus is currently on purchasing land in the watersheds from individual landowners (see section on Watershed Management Activities), private individuals can maintain their land within the

areas of hydrological importance, but with restrictions. In the case of private land, the owner or owners may retain ownership if they respect the limitations established by the municipal ordinance and its regulations (Constitutional Court of Ecuador, 2008).

The fund itself was created by deed, wherein the constituents established the mandates governing FORAGUA.

FORAGUA has the following regulatory and management bodies: a) the Trust Board, which is the highest authority of the trust and formed by the legal representative of each constituent; b) the Directory, composed of five members; and c) the Technical Secretariat, which provides support and assistance to municipalities and ensures the proper implementation of programs and funded projects. The Central Bank of Ecuador collects all payments and the CFN manages the fund (see also Figure 7.9) (Dorado et al., 2011).

On the local level, several members also have Environmental Services Committees. They consist of representatives of local government, water users, landowners with properties in the watersheds, and other interested parties. The idea is that these committees create the possibility for setting joint priorities, support the planning process, and provide supervision (Kauffman and Echavarría, 2013).

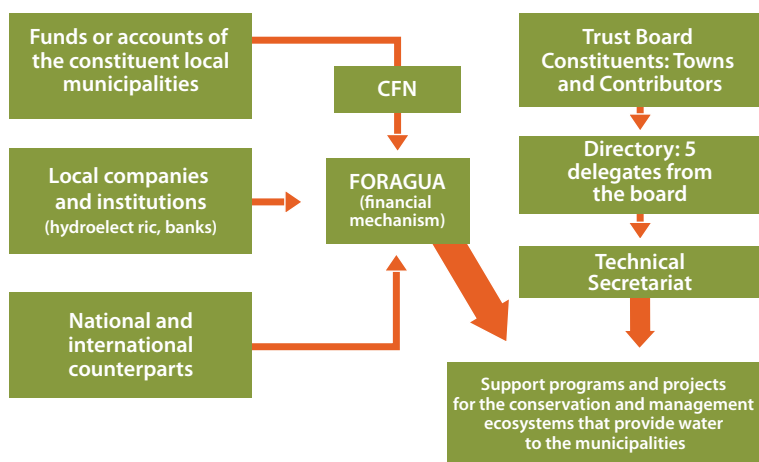


Figure 7.9 FORAGUA's Stakeholders

FORAGUA's Funding

FORAGUA is funded through an environmental services charge and through donor funding. The mechanism is based largely on the willingness of citizens to pay an additional amount on their water bill. As the total costs to implement protection and restoration measures as well as the costs of purchasing land were anticipated to be high, a classification of users following the same categories used by the municipalities was created (i.e. residential, commercial and industrial, and official users). Fees were set trying to average the charge with already existing ones (garbage collection, street lighting, etc.; See Table 7.3).

The municipality of Puyango mentions the following funding sources in its ordinance:

- Charges for environmental services created by the municipal ordinance;
- Financial resources that are allocated by the municipality of Puyango through its budget;
- Funds obtained on the basis of the voluntary donation of 25% of the income tax;
- Contributions, inheritances and donations; and
- Other sources (e.g. international cooperation).

In addition the ordinance assures that this funding cannot be diverted for other uses not related to watershed conservation and restoration activities. Article 14 of the ordinance states that “no official or municipal authority is allowed to assign these economic resources to a different use” (Constitutional Court of Ecuador, 2008).

FORAGUA is an endowment fund (Laurans et al., 2012); it is not the interest generated by the fund but a portion of the fund itself that is used to finance conservation activities in the watershed. Any interest that is generated is used to complement the

	Number of water users (households, businesses)	Environmental charge (US\$)	Amount collected (US\$/year)
Loja	30,000	3-8 cents/m ³	400,000
Celica	910	9 cents/m ³	15,000
Puyango	1,300	11 cents/m ³	18,000
Pindal	481	5 cents/m ³	8,000
Macará	2,683	8-10 cents/m ³	45,000
Zamora	11,000	1 dollar/property	11,000
Chinchipe	754	2-5 cents/m ³	4,000
Palanda	348	4-10 cents/m ³	5,000
El Pangui	1,500	10-15 cents/m ³	22,000
Centinela del Condor	823	4-10 cents/m ³	12,000
ZARUMA	2,162	4-10 cents/m ³	42,000
Total	51,961		582,000

Donor	Objective	Amount (US\$)
Private donations	FORAGUA's establishment	50,000
Flemish forest fund	Setting up of the baseline, equipment, water monitoring	120,000
RARE International	Social marketing campaign and purchase of properties	30,000
Flemish forest fund	Compensation for environmental services	50,000
Private donations	Purchase of properties	500,000
USAID	Strengthening the technical secretariat of FORAGUA	37,000
AQUAYA Institute	Water quality monitoring	35,000
Tinker	Entry of new municipalities	237,000
Government of Flanders	Restoration of degraded areas in the micro-watersheds	114,000
RARE	Environmental awareness campaigns	130,000
NCI	Support for FORAGUA's activities	120,000
Municipality of Loja	International conference	30,000
Total		1,453,000

activities of the Secretariat. The annual amount for investment in the fund is approximately US\$ 600,000 (Table 7.4).

The environmental charge is collected by the Ecuadorian Central Bank to ensure that funds are only used for activities related to watershed protection.

Because the fund's financial resources are public they are invested by the CFN. Of the total funds raised by the environmental charge, 90% of the revenues are reinvested in the municipalities proportional to the amount each municipality collects, and 10% is used to run the Technical Secretariat of the fund (Figure 7.7). The mechanism is designed so that all

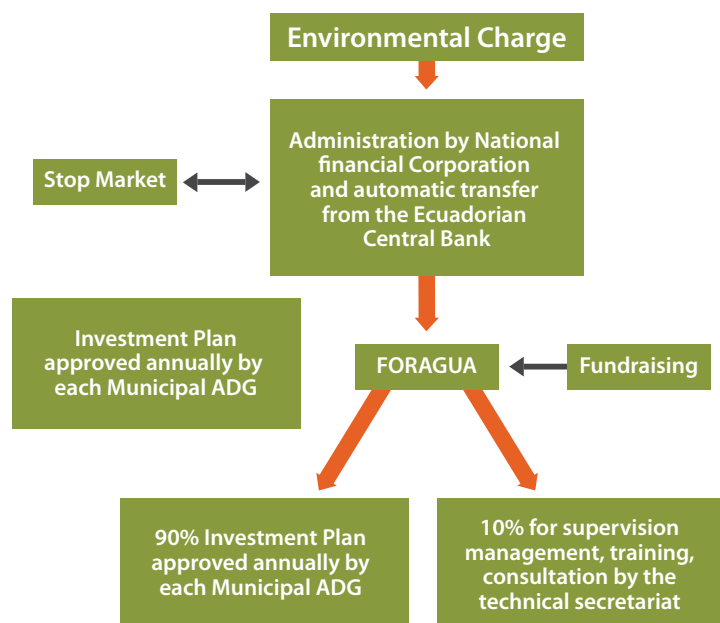


Figure 7.10 Flow of the Money Collected by FORAGUA's Members

municipalities provide their resources to the management of the fund's activities. Each municipality alone could not achieve this because in the case of small municipalities the resources would not be sufficient to manage a technical secretariat or to implement broad conservation activities.

In addition to the funds raised by the environmental charge, it is the task of the Technical Secretariat of FORAGUA to manage resources provided by national and international cooperation, public institutions, and donations (Table 7.4 and Figure 7.10).

Watershed Management Activities

The investment of the financial resources provided by the fund can only be done by implementing an individual investment plan that each FORAGUA municipality has to develop. These investment plans contain proposals for the destination of the funds and must be aligned with the ordinances. The investment proposals fall under the responsibility of the municipal water authorities, such as the municipal water company EMAAL-EP in Loja, and

must be approved by FORAGUA and the Municipal Council on a yearly basis.

The start of a management plan is the zoning of the municipality and mapping of areas of hydrological importance (see section on Watershed Management Activities). For example, the municipal ordinance of Chinchipe states that areas that impact the water cycle, due to factors including location and vegetation cover, are considered priority for conservation. Watersheds, aquifer recharge and water supply sites are particularly important target areas for preservation. This municipal ordinance distinguishes between intangible or permanent protection zones, areas for the recovery of forest cover and the regeneration of natural ecosystems, and areas for agricultural, recreational and other sustainable uses (Constitutional Court of Ecuador, 2010).

The importance of specific areas for the provisioning of hydrological services is measured by the number of beneficiaries served by a particular watershed. The use of maps has been key. Aerial photographs and satellite images have facilitated the identification of current land uses, and provided a clearer picture of the state of the water catchments. Information such as soil types, slope, fertility, temperature and precipitation have also been collected to determine if the current land use is the best within the range of potential uses of that land (GCA, 2006). Natural ecosystems are seen as the best option for ecosystem service delivery. Using this information, it is determined which areas within the watershed are being over-exploited and which should be priority areas to be bought by the municipalities through FORAGUA.

Before the establishment of FORAGUA, some watersheds were already owned and protected by local governments. However, a majority of the watersheds were privately owned and primarily used for raising dairy cattle (Table 7.4). Land purchases are one of

Table 7.5 Area of Pastures and Number of Private Landholders within the Watersheds in 2013

Municipality	Watershed	Number of Hectares of Pasture	Number of Owners
Loja	El Carmen, San Simón, Pizarros, Puritroje, Jipiro y Shucos	No data	49
Macará	Mataderos	491	51
	Jorupe	207	23
Puyango	Luz de América	36	16
Celica	Quira	98	No data
	Matalanga	46	16
	Quillusara	118	51
Pindal	Papalango	247	50
Zamora	Limón	No data	20
Chinchipe	Los Rubies	300	No data
	Chaupe las Minas	70	No data
Zaruma	Giando-Mirmir	No data	25
Palanda	SUHI, Los Molinos	No data	23
Centinela del Cóndor	Zumbi	No data	15
El Pangui	Cayamatza	No data	No data

Source: FORAGUA, 2014

the main activities of the constituents of FORAGUA. The fund has bought approximately 15,000 hectares from 52 landowners.

Although a key component of FORAGUA's management plan is the purchase of land in areas of high importance for hydrological service provision, additional activities for watershed conservation and restoration have also been implemented. Such activities include management and monitoring, the recovery of natural vegetation, compensation for environmental services, protection of water sources, the conservation and protection of property declared as reserves, scientific research, environmental education, and other activities permitted within the municipal reserves. FORAGUA's constituents must provide receipts to guarantee that the funds are only used for acceptable activities (Constitutional Court of Ecuador, 2008; Kauffman and Echavarría, 2013).

When land is purchased it gets integrated into the municipal conservation reserves. However, as

mentioned earlier, landowners within areas of high hydrological importance can also decide to establish a private conservation reserve, with the approval and regulation of the Ministry of Environment. In addition, the Ecuadorian national government has a payment program for conservation and restoration of forest and *paramo* on private lands called Socio Bosque. Currently it is not known if any landowners within the FORAGUA watersheds participate in this program. A type of indirect conservation incentives that has been implemented are payments to landowners in the form of rental contracts.

Within municipal protected areas, FORAGUA's members undertake restoration activities, mainly through reforestation with native tree species. For certain areas of hydrological importance, municipal ordinances also allow production systems, such as pastures and corn, to be replaced by other crops that cause less environmental impact and provide continuous forest cover, such as shade coffee and native fruits (Constitutional court, Ecuador, 2010).

For example, in Pindal there is a project for the promotion of coffee agro-forestry systems instead of intensive corn production. FORAGUA also finances environmental education projects.

To get a clear idea of the impact of the different activities it is necessary to monitor and measure the effects. The absence of monitoring activities can hinder the analysis of whether water funds are effective in providing services (Goldman et al., 2008). According to Farley et al. (2011), in Ecuador most programs financing ecosystem service provision did not conduct baseline ecological analysis. FORAGUA has now implemented a monitoring program to collect information about the watersheds of the municipalities. This baseline study includes maps of land use, vegetation cover, analysis of potable water systems (users, losses, payments, subsidies, cost analysis, water flows) and land tenure. So far all of the watersheds have been assessed in seven municipalities, and assessments are currently being undertaken in the other municipalities.

Challenges and Lessons Learned

A key challenge for many schemes that focus on ecosystem service provision is the fact that there is a need for more information on land uses that will in fact produce the services promised (Farley et al., 2011). Additionally the board of FORAGUA detected the following challenges:

- Slow transfer of revenues from municipalities to the CFN;
- Lack of enforcement of the ordinances by municipalities;
- Little citizen engagement;
- Low collection rates of the environmental services fee and high default rates;
- Lack of technical staff for the Secretariat;
- Limited budget of the Secretariat;
- Lack of political will of some constituents;

- Lack of a communication strategy that informs society of the value of the fund and raises public awareness, engagement and support, especially during periods of political instability;
- No implementation of investment plans;
- Heterogeneity in politics and political affiliation of the municipal autonomous decentralized governments;
- No connection with the National Secretariat for Water (SENAGUA);
- Conservation areas are excluded from land use plans. No representation of taxpayers and water users on FORAGUA's board (FORAGUA, 2013);
- The fund has thus far failed to achieve behavior change among landowners.

When small municipalities join together, they can create economies of scale that make a water fund possible. Collaboration also facilitates the transfer of knowledge and good management practices; it makes solidarity between smaller and bigger municipalities possible, and it strengthens the possibility of applying for national and international financial aid. Additionally, according to Kauffman and Echavarría (2013), a trust fund can make it easier to receive external donations as donors may be reluctant or forbidden from providing money directly to government entities. Private trusts provide a mechanism for overcoming these difficulties. Trusts can also provide protection against the changing priorities of elected officials and political instability that can lead to the diversion of funds.