

# Reciprocal Water Agreements, a new approach on watershed conservation?

A case study from Cuenca, Ecuador.

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Contract-based watershed conservation, such as payment for watershed services (PWS) is increasingly used to tackle water shortages and low water quality in the Andean area. In recent years, a specific kind of PWS has emerged in this field. Reciprocal Water Agreements (RWA) follow the basic idea of PWS, but rely more on social exchange and values, rather than on market-based cash flows. This study's objective is to identify special features in the application of RWA in Cuenca, Ecuador, and to determine potential improvements of RWA in comparison to PWS. For this purpose, I analyze the implementation of RWA in the watershed of Yanuncay, a water supply area of Cuenca, where RWA had been implemented in 2011. The analysis demonstrates that the reciprocal contracts were thoughtfully adapted to the social and environmental conditions and individually negotiated with the service providers. To reduce the burden of transaction costs, the implementing institution (RARE) applied standardized procedures and used available data [resources.Instead](#) of monetary incentives, as commonly used in PWS schemes, ETAPA (the principal customer) compensates Yanuncay's land owners with a periodic supply of agricultural materials and training to encourage a shift in the land use practice and ameliorate the farmer's productivity. As the incentives' financial value is significantly lower than the calculated opportunity cost, it gives the opportunity to negotiate with owners of large properties. This model stands in contrast to PWS and suggests positive effects in the long run. Based on the observations in the watershed of Yanuncay, Reciprocal Water Agreements can be considered as a promising tool for watershed conservation. Nevertheless, the case study shows that RWA projects can be affected by the typical problems of PWS such as free riding, non-transparent financial mechanisms and mistrust on the participants part.

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## 1 Introduction

A human's life on earth is completely dependent on the services provided by nature: the provision of food, fresh-water and fiber as well as the ability to degrade pollutants in water, air and soil (Millennium Ecosystem Assessment 2005: 7). Despite the importance of these ecosystem services (ES) the environment is put under extreme pressure by mankind, which results in the fact that many ecosystems "are being degraded faster than they can recover" (Millennium Ecosystem Assessment 2005: 39).

One approach to "capture at least some of the financial value of these services" are market-based conservation approaches, such as payments for ecosystem services (PES) (Leimona et al 2015: 16). The idea of PES is to generate a direct contractual agreement between the supplier and the buyer of an ecosystem service. Following Sven Wunder, a PES can be defined as a voluntary transaction (a) where a well-defined ES (or a land-use likely to secure that service) (b) is being 'bought' by a (minimum one) ES

buyer (c) from a (minimum one) ES provider (d) if and only if the ES provider secures ES provision (conditionality) (e) (Wunder 2005: 3).

Since the early 2000s, this instrument has gained importance. Nowadays one can find various types of PES projects on different scales all around the world. This suggests, that the PES scheme is gaining popularity. However, opponents of this scheme have raised several criticisms. Various PES schemes are being criticized for neglecting local structures and being created without the participation of inhabitants (Rodríguez de Francisco 2013: 98). Other examples demonstrate cost-ineffectiveness and struggle to finance projects in the long run, or fail to generate a positive impact on ecosystem services (Pattanayak 2010: 5). In addition, PES schemes ask for environmental valuation of ES which is connected to a wide range of methodological and theoretical problems. As a response, there are new subtypes of PES emerging which aim to address some of the criticisms of PES.

The present article takes a closer look at one of these new approaches: Reciprocal Water Agreements (RWA). It all began with a local initiative from the Santa Cruz valley in rural Bolivia, where water related forest conservation by the participating farmers is compensated with beehives as well as training in honey production. These incentives are financed by the downstream population paying contribution into a water fund (Asquith 2011: 58f). Escorted by the Fundación Natura Bolivia, a local NGO, and later UNEP's and RARE's 'Communities for Conservation' project, the idea of RWAs spread across South America (UNEP 2014).

The general conception of RWA is close to that of payment for watershed services (PWS), which is a type of PES used to ameliorate watershed services such as water quality, water quantity and productivity (MA 2005: 61). However, in contrast to PWS, RWA are introducing several new principles such as transparency, local institutionalization, a permanent financial mechanism and additionality (Rodríguez-Dowdell et al. 2014: 54). RWAs are "locally designed, financed and managed" (Rodríguez-Dowdell et al. 2014: 10), therefore, they are adapted to the site's structures and consider themselves as a bottom-up approach. This is different from most PES projects as there are no cash-incentives. RWA favour in-kind payments that are promoting the adoption of more environmentally friendly agriculture (Rodríguez-Dowdell et al. 2014: 49). The idea is built on the value of reciprocity: If you help me protect the ecosystem and secure water provision, I help you with your farming practice (Bétrisey and Mager 2014: 372).

Though there is already a considerable number of projects applying this approach on watershed conservation, it received rather little attention in the literature. This study

contributes to fill this gap by examining the Ecuadorian case of the Yanuncay watershed where RWA were implemented in 2011.

This study examines the implementation based on project-specific publications, internal documents and a literature review, complemented by stakeholder interviews that were carried out with staff members of involved institutions. The main focus is laid on the identification of special features, and might represent an improvement compared to other PWS schemes.

The following chapter will briefly describe the spatial, social and institutional context of the project. Subsequently, the main part of the article is an analysis of the different elements and special features of the watershed conservation project. The paper concludes with a small summary of the study's outcome and a discussion of the potential of the RWA approach.

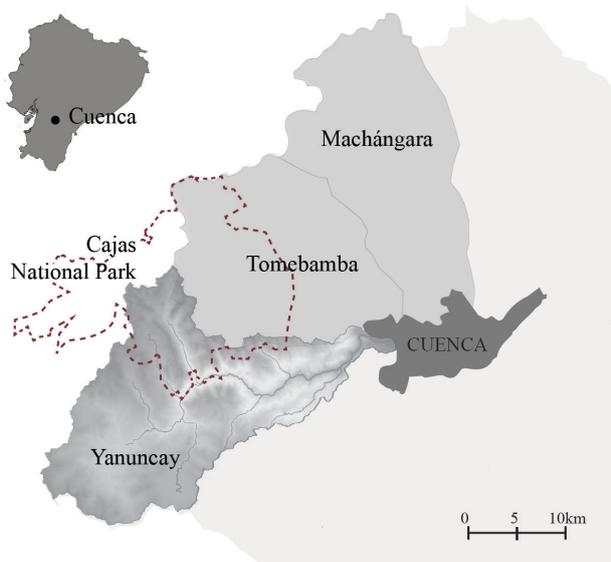
## 2 Description of the case study area of the watershed of Yanuncay

The watershed of Yanuncay is one of the three main watersheds responsible for the potable water provision of Cuenca, Ecuador's third biggest city. The rivers Machángara, Tomebamba and Yanuncay all descend from the surrounding páramo (Buytaert 2006: 61), an ecosystem that is solely found in the Andean area, and known for its hydrological characteristics, providing a high and sustained base flow and excellent water quality (Buytaert 2006: 54). Despite its importance, the páramo is highly endangered by human intervention such as cattle grazing, intensive agriculture or pine planting, resulting in erosion and land drying (UNEP 2009: 28f).

As the city's water demand is high and still expected to rise, ETAPA, the municipal water company, sees watershed conservation as one of its main tasks. Since the 1980s, the company started several projects including the purchase of critical areas around the Tomebamba watershed and the creation of the Machángara Watershed Council (Echavarría et al 2004: 37f). These activities were predominantly financed by a surcharge on the user's water bill (between 1% and 5%) that is collected in a water fund (Espinosa 2005: 17).

For the watershed of Yanuncay an installation of a direct payment for watershed service program was intended, but the implementation of their so-called Conservation and Development Agreements failed because of "opposition and mistrust in the target communities." As a result, the company decided to join the 'Communities for

**Figure 1:** Location of Cuenca and its watersheds



Source: ETAPA 2012: 8, adaption by the author

Conservation project<sup>1</sup> and to implement Reciprocal Water Agreements (ETAPA and RARE 2011: 9, Alan Hesse 2016, pers. comm.).

Within the watershed, 3,768 hectares had been set as area of high hydrological value. This area is located between the community of Soldados and the catchment area of the Sustag treatment plant (Figure 1). The resident population is traditionally involved in dairy farming. More than one third of the area's inhabitants is depending on this economic activity and an estimated 85% of the cultivated areas are used as pasture (ETAPA and RARE 2011: 25). Due to the relatively high income from milk production (UNEP 2014: 82) there is a strong interest in gaining more cultivated land by converting the páramo ecosystem into fields. A distinction can be made between two types of landowners: farmers with small and medium sized properties who live in the community of Soldados, and farmers who live outside of the community which are owners of larger properties (ETAPA and RARE 2011: 25).

### 3 Analysis of implementation

In this chapter, the essential stages and characteristics of setting up Reciprocal Water Agreements in the watershed of Yanuncay are being examined. The focus is set on

<sup>1</sup> "Communities for Conservation (CfC): Safeguarding the World's Most Threatened Species" was a watershed conservation project that took place between January 2010 and August 2013. In total CfC had a budget of 4.5 million dollars, financed among others by the Environmental Fund (GEF), RARE Conservation and the Alliance of Zero Extinction (AZE) (UNEP 2014). In twelve sites across the Andean area of Ecuador, Colombia, Bolivia and Peru RARE as the executing organization worked together with local partner organizations and institutions to implement Reciprocal Water Agreements (GEF 2009: 7).

the contracts themselves and the mechanism of action. Moreover, critical issues around payment for watershed services, such as additionality, voluntariness and sustainability, are discussed.

#### 3.1 Project preparation

The project started in early 2011 with an intensive preparation phase. The objective of this phase was to assess the current state of the watershed, stake-out the project area and identify potential threats for hydrological resources, as well as important stakeholders.

This RWA project began with obtaining environmental and hydrological data. This indicates that the Yanuncay project was grounded on applied research, which in contrast to many PWS schemes are lacking hydrological information because they are based on the generally accepted conception that forests ensure water supply (Farley et al. 2011: 397). Parameters regarding water quality and water quantity were measured using a protocol by the Natura Bolivia Organisation which ensures comparability during the monitoring phase. Moreover, the land cover and land use was surveyed and mapped, and information about the local fauna and flora were collected. In order to lower transaction cost available data resources were included (ETAPA and RARE 2011: 82f).

Additionally, a stakeholder analysis was carried out. The RWA approach highlights this methodology, as the first step to encourage local support. It is important to know and understand local stakeholders, groups and institutions that affect the implementation, their motivation and attitude regarding the project as well as their social relations and power structures (Asquith, Wunder 2008: 5). The focus of this scoping phase was to determine their potential contribution to the project, the importance of winning them as allies and the threat of neglecting their participation (ETAPA and RARE 2010: 44-53).

#### 3.2 Participant selection and negotiation

High transaction costs and the limited amount of resources emphasize the importance of a careful selection of landowners that should be included in a payment for watershed service scheme and the negotiation process (Asquith and Wunder 2008: 11f). This decision is usually based on environmental, economic, legal and social factors. PWS projects have their own way in valuing these aspects. Mistakes committed during this phase can result in multiple problems, including failure of the whole project (Smith et al. 2006: 61ff).

For selecting participants RWA projects highlight the principle of additionality. Additionality can be described as "the actions and effects that would not have occurred

without the scheme" (Smith et al. 2006: 49). In the case of the participant selection for RWA in the watershed of Yanuncay, three proxy criteria were used to ensure additionality: The contracts should be signed (1) where there is the possibility to recover riparian fringe, (2) where the property can serve as a buffer zone for a protected area, and (3) where there is a high threat to lose the ecosystem (Rodríguez-Dowdell 2016, pers. comm.). The compliance with these requirements is apparent, as all selected landowners are involved in cattle ranching, an activity that strongly adversely affects hydrological resources, and owners of properties with a share of riparian vegetation that are situated close to protected areas, especially the Cajas National Park.

Even though there are RWA projects that offer landowners the possibility to obtain or clear the legal status as an upfront incentive for participating in the scheme, (Rodríguez-Dowdell et al. 2014: 24, Alan Hesse 2016, pers. comm.) ETAPA, as a public company, decided to enter solely into negotiation with lawful landowners (Bustamante 2016, pers. comm.). Since only around 25% of the population of Soldados legally own their land, (ETAPA and RARE 2011: 30) it seems reasonable to assume that a high percentage of landowners in the Yanuncay watershed are being excluded from gaining entrance to the scheme due to property issues.

As a result of the selection process, 36 landowners with properties suitable to implement a Reciprocal Water Agreement were identified in this area. These properties follow the above-mentioned criteria such as the status of land tenure and the principle of additionality. Finally, 13 landowners entered the negotiation process (Bustamante 2016, pers. comm.).

The negotiation phase is probably the most sensitive element of the creation of a payment for ecosystem service project, since it is subject to interpersonal and social issues. Individual landowners are considered as the most critical stakeholder group, especially in the Andean area. There is general mistrust towards watershed projects, since the landowners fear that somebody wants to take away their land (UNEP 2009: 18).

The project of Yanuncay encountered several issues during its implementation. In addition to general difficulties, such as the mistrust caused by the heterogeneity of the actors, the relationship between ETAPA and the population of the Yanuncay valley was biased, especially in the settlement of Soldados. In the last few years there had been multiple conflicts between the two parties: ETAPA blamed the villagers of Soldados for severe flood damage, as the farmers maintain deforestation practices (Eltiempo 2015). The company tried to stop landowners from working their land, like plowing the paramo, and they are currently involved in the planning of a dam in the Yanuncay valley, a project which is vehemently opposed by the Soldados community

(El Mercurio 2010). Despite problem-solving attempts and personal meetings of the involved parties, the whole project was compromised by these social issues.

The contracts were negotiated individually with each landowner, as it usually is the case for Reciprocal Water Agreements, to make the agreements "fit the individual, ecological and social context." (Rodríguez-Dowdell et al. 2014: 32). Employees from ETAPA conducted regular visits to discuss contract components such as the actual conditions respectively commitments, the kind and amount of incentives and penalties for non-compliance (ETAPA and RARE 2011: 60).

The first negotiation phase resulted in five contracts, covering 505 hectares of land. All signatories are people living outside of the community of Soldados, which suggests that the conflicting relationship between ETAPA and the community members had not been overcome (ETAPA and RARE 2011: 77).

### 3.3 Contract characteristics and commitments

Reciprocal Water Agreements are legally-binding agreements, therefore signed in the presence of a notary who ratifies the contract including the non-compliance clauses (Hesse 2016, pers. comm.). Although non-compliance could potentially be remedied using the judicial system, the RWA approach is striving for contracts that are considered predominantly as social contracts, "preferably endowed with a sense of mutual trust and only reinforced by points of leverage" (Rodríguez-Dowdell et al. 2014: 19). In Yanuncay, for instance, participants only receive some of the rewards on a recurrent basis if they prove that they are respecting the contract obligations (ETAPA 2011: 2).

Though most RWA projects use five-year contract periods, the contracts in the Yanuncay valley are signed for 10 years, a decision that can be considered as having a direct impact on lowering the transaction cost (Rodríguez-Dowdell et al. 2014: 31). The contracts are going to be re-negotiated in 2021. Another particularity of the Yanuncay case is that there is a clear differentiation between the first five years of the intervention, in which an intensive implementation phase takes place, and the second half of the contracted period that rather corresponds with tracking and monitoring procedures (Bustamante 2016, pers. comm.).

The core element of each Reciprocal Water Agreement is the section where the commitments from both parties are clearly set. Although the detailed conditions and the extent of the contract are individually negotiated, some general commitments can be identified. In the case of the Yanuncay watershed these commitments are as follows: (see Table 1)

**Table 1:** RWA commitments of the contracting parties in the watershed of Yanuncay

The owners commit to	In return ETAPA commits to
yield a strip of at least 5 meters wide along the Yanuncay river.	support the improvement of pastures in an area of equivalent size to the owner's protected riparian forest.
attend agricultural training carried out in cooperation with the INIAP.	perform analysis of soil, pasture and the chemical composition of the pasture.
keep the fences in good condition.	delegate a technician to accompany the RWA conservation process.
maintain the agreed land use, replicating good farming practices and refrain expanding the agricultural frontier.	deliver inputs and fertilizers, a veterinary first aid kit and fencing material.
prevent cattle of entering scrubland/paramo.	conduct training in sustainable livestock farming and provide technical advice.

Source: ETAPA and RARE 2011: 75, ETAPA 2011:3f

The owners' commitments are directly corresponding with the environmental output of the project. Figure 2 shows the anticipated environmental improvements.

The contract terms are chosen to generate positive environmental effects under the premise of additionality. Firstly, the landowners agree to build a fence along the Yanuncay river. This allows the formation of riparian vegetation, which acts like a filter for sediment, pesticides or other water contaminants (Dudley 2003: 61).

Secondly, the protection of the paramo is emphasized by preventing cows from entering the sensitive ecosystem and by prohibiting the expansion of the agricultural frontier. These are very important precautions, as the paramo is contributing to steady stream flows and serves as home for many endangered species (Buytaert 2006: 54).

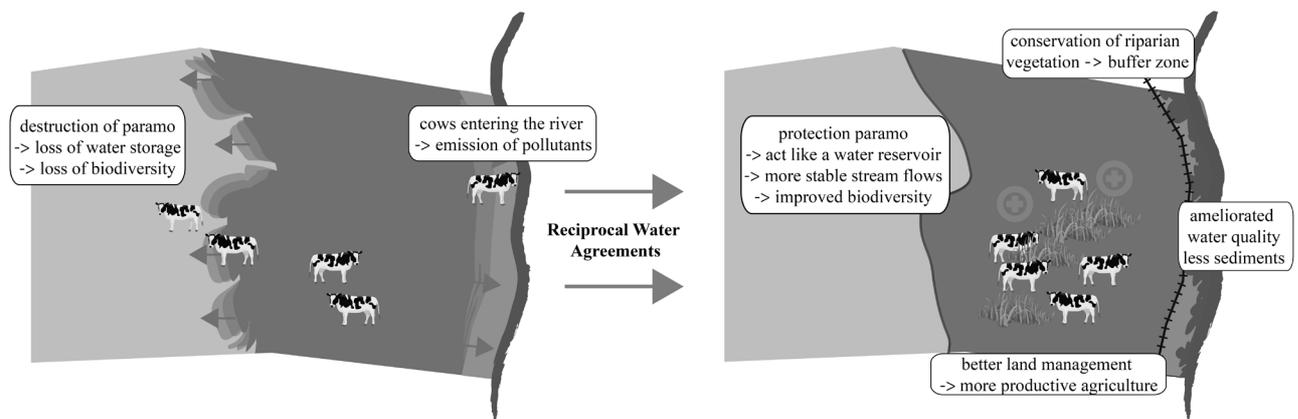
### 3.4 Incentives

Just like payment for watershed service schemes the RWA mechanism aims to tackle environmentally harmful behavior and/or to ensure the maintenance of certain land uses through positive incentives (Smith et al. 2006: 33). Most PWS schemes use cash payments, which may be easier to manage and are more flexible. However, RWA exclusively use in-kind incentives (Rodríguez-Dowdell et al. 2014: 16).

In contrast, to PWS projects that simply reward a certain kind of land use, RWA provide a trade of incentives to land owners which actively contributes to environmental protection. Which goods are used differs from site to site, with the purpose to be a livelihood assistance that allows the farmers to maintain on-farm reserves while improving their productive practices (GEF 2009: 17).

The incentives or rewards, that are used in the Yanuncay watershed are threefold: material, training and analysis. The INIAP (Ecuadorian Institute for Agricultural Research)

**Figure 2:** Effects of RWA in Yanuncay, presentation by the author



Source: (ETAPA and RARE 2011: 75, ETAPA 2011: 3f); own presentation

conducted analyses of the pasture, the soil and the chemical composition of fertilizers that are used on the properties. Based on the results the farmers were shown how to improve their dairy farming practice. The training sessions included a health module, lessons on how to produce silage and advice on breeding cattle. Additionally, more environmentally friendly farming practices were shown to the farmers. For example, silvopasture, which is a combination of forage and livestock production, addresses the common problem of decreasing fertility of the soil (ETAPA & RARE 2012: 6). The training started in June 2011 and was conducted on a monthly basis until February 2013 (ETAPA 2011: 3). To assist the farming activities, the landowners were given supplies such as fencing material in order to protect the riparian vegetation. They also received goods, such as seeds, fertilizers and a veterinary kit. The regular delivery of goods is tied to the compliance monitoring and can only be received if the monitoring report is favorable (ETAPA 2011: 4f).

The idea behind PWS is to make practices that are "unprofitable but socially-desirable", such as environmental conservation, "become profitable." (Engel et al. 2008: 670). Ecological farming and the conservation of natural landscape are connected with a loss in income. The income gap between protection and non-protection is compensated by the PWS scheme<sup>2</sup> (Goldman-Benner et al. 2012: 58). Projects that use RWA determine the opportunity cost of land use changes in advance of the negotiation and use this figure as a reference value. As explained by Natalie Rodríguez-Dowdell the real level of incentive "depends on the needs to improve the situation and is based on what is defined in a participatory land use planning." (Rodríguez-Dowdell 2016, pers. comm.).

In the watershed of Yanuncay, all farmers were given the same training and analysis, the amount of material that was offered by ETAPA is proportional to the property size. A so-called 1:1 negotiating was applied: for each hectare of riparian forest fenced off the farmers are given material to improve their farming practice in one hectare of their property. The same procedure is used in areas that need to be restored. However, in this case, the ratio is 0.5:1 (Natalie Rodríguez Dowdell 2013: 5). An evaluation of the farmers' income is part of the monitoring and the level of incentive might rise if the farmer decides to increase the riparian conservation area, which is possible any time during the contract period (ETAPA 2011: 4f).

The approach highlights the concept that there is no need to transfer a monetary sum that is covering "opportunity cost" as an incentive. The final goal being that the land-

owner's economic position and livelihood is not negatively affected by participating in the PWS/RWA scheme. Moreover, the approach offers a possibility to negotiate with owners of large properties, thereby mitigating foregone profits. Without this scheme, the conservation activities would not be economically viable (Rodríguez-Dowdell 2016, pers. comm.). In Yanuncay, the relatively high income of livestock farming made the implementation of a contract-based conservation scheme in the watershed complicated (Echavarría et al. 2004: 42). In this case, it is in doubt whether a payment for watershed service scheme rewarding the farmers with the calculated opportunity cost in cash would ever be economically feasible.

A common problem of PWS projects is that they create a dependency of the farmers on regular financial assistance. Ongoing conservation is tied to ongoing payments (Van Hecken, Bastiansen 2010: 789). In contrast, the RWA approach strives to show the farmers techniques that are self-sustainable in the long term (Rodríguez-Dowdell et al. 2014: 32). Assuming that they are successful, this would mean that the farmers can maintain their conservation practice and livelihood even when the delivery of goods and services stops.

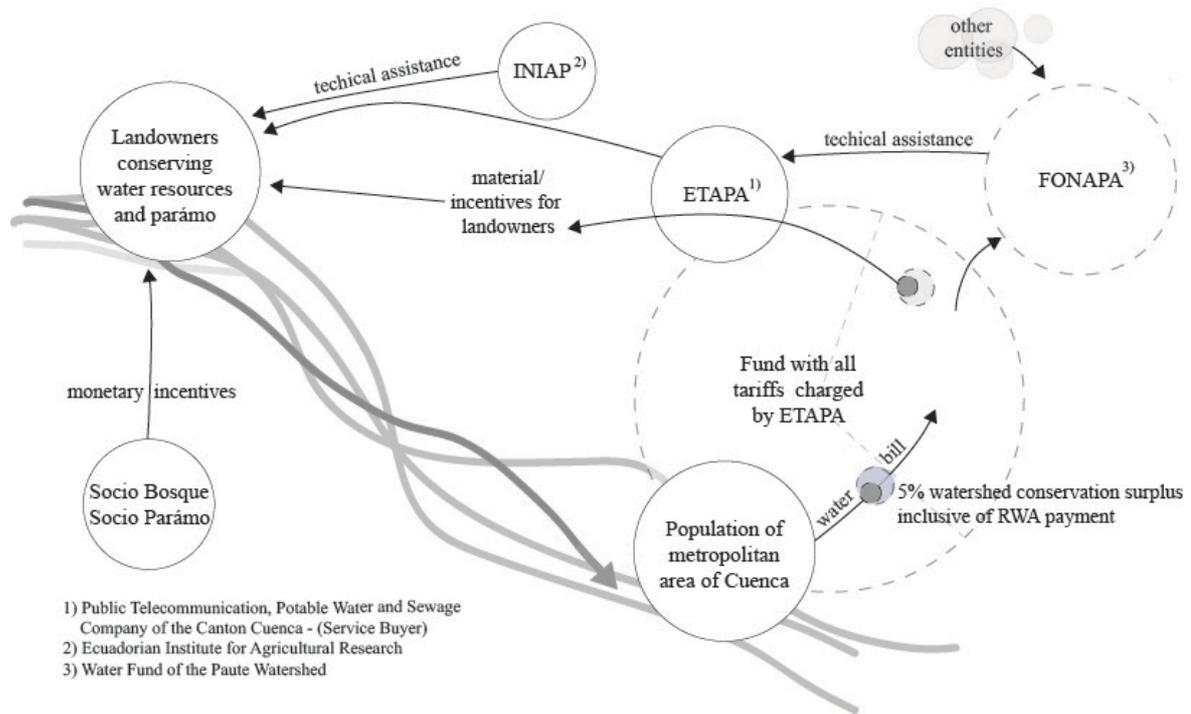
Despite the fact that there is qualitative data of a positive impact of RWA on the farmers livelihood, the project failed to include appropriate indicators to enable the drawing of scientific conclusions. This is one of the major weaknesses of the project and whole 'Communities for Conservation' program (UNEP 2014:87).

### 3.5 Payment mechanism

Part of each RWA project is a permanent financial mechanism that ensures long-term viability and covers the running cost of the program, including not only the acquisition of the farmers' incentives but also management and monitoring costs (Mayrand and Paquin 2004: 26, Rodríguez-Dowdell et al. 2014: 28).

Related to ETAPA's previous efforts to finance watershed conservation, there was no need to create new financing structures. In 2001 the company introduced a fee of USD 0.05 for the protection and management of watersheds on the price of each metered cubic meter, an amount that had been calculated to finance the investment and operating costs of ETAPA's watershed program. ETAPA supplies over 300,000 inhabitants of the urban core and in certain peri-urban areas of Cuenca (Inter-American Development Bank 2006: 1). The watershed toll generated USD 1,3 million in 2011 of which USD 200,000 were used to finance the implementation of the Reciprocal Water Agreement program (ETAPA and RARE 2011: 25). In May 2015 ETAPA

<sup>2</sup> Still, it is not unusual to find examples of PES projects that offer incentives that are significantly lower than the opportunity cost, such as the example of Pimampiro in Northern Ecuador (Rodríguez de Francisco 2013: 92). In this case the farmer's quality of life was significantly impacted.

**Figure 3:** The financial mechanism in the watershed of Yanuncay


Source: Own presentation

doubled the cost of potable water, due to budget deficits and the increasing costs of water production (Eltiempo 2015). As a result, there had also been a relative increase of the watershed protection fund (pers. comm. Bustamante 2016).

The money, though it is assigned for conservational purposes, is collected together with all tariffs charged by ETAPA, including not only water but also internet, telephone and television (pers. comm. Bustamante 2016). The following figure shows the flows that contribute to the long-term sustainability of the project.

On the one hand, the water user's contribution, which is collected in ETAPAs fund, is shown. The river Yanuncay can be considered as the connecting element of this process. On the other hand, additional stakeholders involved in compensating the property owners for their environmental efforts, like the INIAP and the Socio Bosque/Paramo program, are depicted. Another institution that has to be mentioned at this point is FONAPA (Fondo Nacional del Rio Paute). FONAPA is a regional water fund that is constituted by public and private entities, with ETAPA as its main stakeholder. It is specialized in providing technical and financial support for conservational activities in the watershed of the Paute River, in which Cuenca is situated. Moreover, it generates interest for its trustees and raises money for watershed conservation (FONAPA 2016, UNEP 2013: 25, pers. commu Alan Hesse).

Generally, the transparency of the financial mechanism must be criticized. There are neither publications nor public documents concerning the funding of the project's running costs. By collecting all fees together and by different transferring processes it is difficult to retrace the monetary flows.

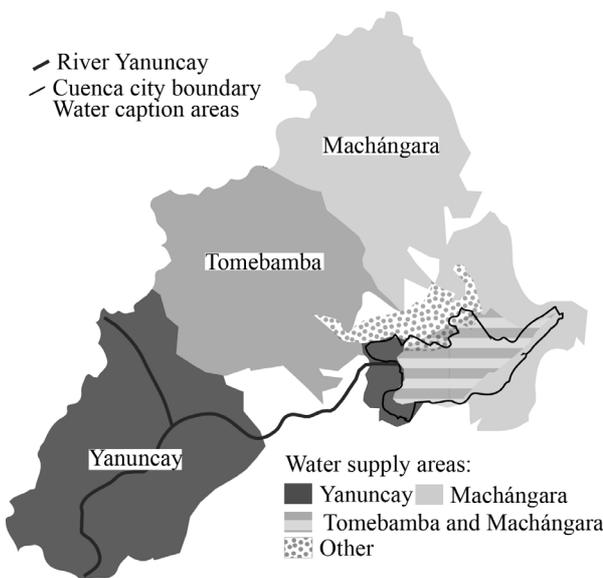
The water user's willingness to pay usually plays a major role in establishing a user financed watershed program (Smith et al 2008: 41). This is not the case for Yanuncay, as the criterion of voluntariness is not given for the service buyers. The water users are not only involuntarily but also unknowingly contributing to watershed conservation. As a part of the RWA implementation, Cuenca's population was informed about their current role regarding watershed conservation, but since their contribution is tied to the water supply, they cannot withdraw it without losing their general water connection (ETAPA and RARE 2011: 70f).

In general, it is the purpose of user-financed PWS schemes that the people who are paying for the scheme are the actual beneficiaries of improved hydrological resources. As hydrological goods and services have a (generally) non-excludable characteristic it is difficult to prevent people from free riding (Kolinjivadi et al. 2014: 146). In the case of Yanuncay, only the water users that are metered by ETAPA pay a water fee. Inhabitants of the Yanuncay valley, who receive their water directly from the river or from small community systems of downstream communities such as San José, Inmaculada and Sústag are therefore not paying for the improvement of hydrological services.

An interesting result of this study is, that the number of people who contribute financially without benefitting of Yanuncay’s water resources significantly surpasses the high number of free riders. Figure 4 shows the water supply and caption areas. One can see that the river Yanuncay is only responsible for the water supply of a small region in the west of the city (depicted in dark grey). Still, all urban water users are paying the watershed conservation fees and the payments of those who are living outside of the Yanuncay supply area can be understood as contributions for which there is no good or service in return.

In summary, only a small share of the service buyers are actually also service users and vice versa. Still, it can be assumed that this does not pose a real problem for the project, as the financing is primarily tied to Cuenca’s water demand, which is expected to rise in the coming years (ETAPA 2016).

**Figure 4:** The water caption and supply areas of Cuenca



Source: ETAPA 2012, adaption by the author

### 3.6 Monitoring procedure

There is a differentiation between two main types of monitoring: Compliance monitoring, if the land owners fulfill the contracted conditions, and monitoring of effectiveness. While most PWS projects apply the former, many lack in providing information about the real environmental impact of their action, usually due to the high cost of scientific research (Farley et al. 2011: 397). In the case of Yanuncay, compliance is determined through regular visits of the contracted properties, which are conducted in advance of each material delivery. Part of these inspections are, for instance, to ensure that the fences are in good condition

and that the cattle graze only in the intended areas (ETAPA and RARE, 2011: 81).

In the case of severe non-compliance, there is a contract clause stating that the landowner is obligated to return 75% of the received incentive’s value in cash (whether goods or service). Moreover, the contracts are immediately dissolved (ETAPA 2011: 5f). According to Marco Bustamante, so far there have not been any breaches of the contracted conditions (Bustamante 2016, pers. comm.).

Regarding the evaluation of environmental effectiveness, three subjects are being reviewed. First of all, water samples are taken and analyzed every month to examine water quality, temperature, turbidity levels, perturbations and the occurrence of fecal coliforms (Rodríguez-Dowdell et al. 2014: 51). Secondly, changes in land coverage are detected by comparing the land use maps that had been created during the implementation phase in the watershed of Yanuncay and of an additional control site (ETAPA and RARE 2011: 19). Thirdly, there is on-site research to determine the number of endangered amphibians within the watershed (UNEP 2014: 23). Many of the monitoring procedures are predesigned, following a certain structure and protocol that is applied to all RWA/RARE sites. This approach is not only less expensive because of the predeveloped procedures but also aiming at facilitating the monitoring and reducing (transaction) costs, by using inexpensive procedures that are easy to perform. Tasks that still require more scientific knowledge, such as the biodiversity studies, are outsourced, enabling shared responsibility of the monitoring procedure. As already mentioned, there was a lack in livelihood indicators (UNEP 2014:87).

## 4 Conclusion

In the framework of resource scarcity and the growing pressure on hydrological resources in the Andean area there is a call for conservation approaches that fit the complex environmental and social context of this part of the world. One of these approaches are Reciprocal Water Agreements, which can be considered as an interesting new tool for watershed conservation.

The analysis of RWAs in the Yanuncay watershed shows a variety of special features, most of them enabling an easier installation of a scheme or promising positive long-term effects. RWAs are, in contrast to standardized PWS contracts, individually negotiated, to take local specifics and personal preferences into account. During the creation of a knowledge basis as well as the monitoring procedure, the use of protocols, external information and allies is emphasized. This lowers the transaction cost without neglecting scientific standards. Despite this, the project in Yanuncay failed in providing sufficient liveli-

hood indicators, as it is unfortunately the case with many PWS programs.

The sustainability of the financial mechanism can be assessed as high, because it is tied to the water demand of the whole city, and there are more people who contribute to the water fund than people who benefit from the Yanuncay project. Still, there is a not negligible number of communities who free ride on the system as they are not directly metered by ETAPA. Moreover, the project financing is not transparent which contradicts the RWA premises.

Troubled social relationships can, as the study demonstrates, compromise any project irrespective of its design. The selection procedure in advance of the negotiation is, regardless of interpersonal issues, comprehensive and based on clear rules and the principle of additionality. This as well as the commitments are likely to generate a positive environmental outcome, for instance by fencing off the riparian area, which has a direct positive impact on water quality.

There can be some lessons learned from the project in Yanuncay. The most important issue is concerning the application of periodically delivered farming goods and training as in-kind incentives. The goods are chosen to encourage a long-term shift in the land use practice and to improve the farmers' productivity without creating a

dependency on the delivery. The amount of incentives is not corresponding to calculated opportunity cost. That being said, the project emphasizes an improvement in farmer's livelihood. This procedure as well as the contracted commitments can serve as a model for other projects, as they are likely to generate a positive environmental outcome, for instance by fencing off the riparian area, which has a direct favorable impact on water quality.

One of the most important lessons learned in Yanuncay is concerning the application of farming goods and training as in-kind incentives. The periodically delivered items are chosen to encourage a long-term shift in the land use practice and to improve the farmers' productivity without creating a dependency. The amount of incentives is not corresponding to calculated opportunity cost. That being said, the project emphasizes an improvement in farmer's livelihood. This might as well enable the creation of projects in areas where they were not economically feasible by now.

To conclude, RWA are a promising tool for watershed conservation, as they take crucial problems of payment for watershed service schemes into account and offer a concept that emphasizes simultaneously the local scale and a meta-structure, facilitating the implementation of projects. Such contracts offer an opportunity for long term environmental protection not only within the Andean area but globally.

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