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The impact of changing livelihoods on micro water basins in Esmeraldas, Ecuador

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- The views expressed in this document are those of the author and do not necessarily reflect the views of Protos-

Abstract This study discusses the challenges faced by the canton of Rioverde in Esmeraldas, Ecuador in terms of integrated water management. Furthermore, it develops a methodology for the setting up of water basin management plans. Review of secondary information, interviews with authorities and associations as well as a set of focus group discussions with inhabitants revealed the environmental degradation taking place in the area. Biophysical and chemical analysis of water samples showed a deterioration of water quality in the different micro basins. Factors impacting the micro basins water quality were found to be mainly of local anthropogenic origin: bathing of cattle in the river, cleaning of laundry, discharge of excrements and sewage water in water sources, agrochemicals used for agriculture and for capturing shrimps, disposal of garbage and cleaning of spray devices chainsaws directly in the river as well as soil erosion, contamination and alterations in the hydrological cycle linked to land use changes (e.g. deforestation). Results evidence that this environmental deterioration is related to rapidly changing lifestyles and immigration in the zone combined with a lack of mitigation and control measures by local authorities as well as lack of access to basic services. The change of livelihoods from mainly subsistence oriented activities in the 80s to cash generating activities was promoted by the credit scheme of the Ecuadorian Government 'Fondo de Fomento Popular' which encouraged inhabitants to raise cattle for commercialization, eased by the introduction of technology and driven by market demand. The study highlights the influence of policies and changing paradigms on environmental conservation and the challenges to counter environmental degradation in the area.

Keywords changing livelihoods, integrated water management, water basin, Esmeraldas, environmental conservation, deforestation, cattle

Need for integrated water management Protos has been working in the province of Esmeraldas since 2007 on water and sanitation, in this framework it has installed a water treatment plant in the micro basin of Mate (Figure 1), providing water for Altamira, Guariche and Chunguillo from the river Mate. This micro basin mainly relies on agriculture and cattle holding for income, in the parish head Rocafuerte artisanal fishing is the main income-generating activity (GADP Rocafuerte, 2015; FMLGT, 2011). The necessity to work on integrated water management emerged from the observation of inhabitants that water quality and quantity was deteriorating. *"It used to be enjoyable to take a cup of water of the river, now it is poison"* (inhabitant of Rocafuerte, PRA). This deterioration was confirmed by analysis of water samples of the river near the plant (CEFODI-Protos, 2013), with all parameters for the downstream area exceeding national norms. This is of particular concern since more than 30% of the inhabitants of the micro basin depend directly on the river and its tributaries for drinking water and hygiene and more than 60% rely on water distribution trucks (INEC, 2010) which take water downstream in the Mate river, around Altamira (PRA, observations). This water is distributed without particular treatment, only chlorine is added (this study did not allow to verify that this effectively happens).

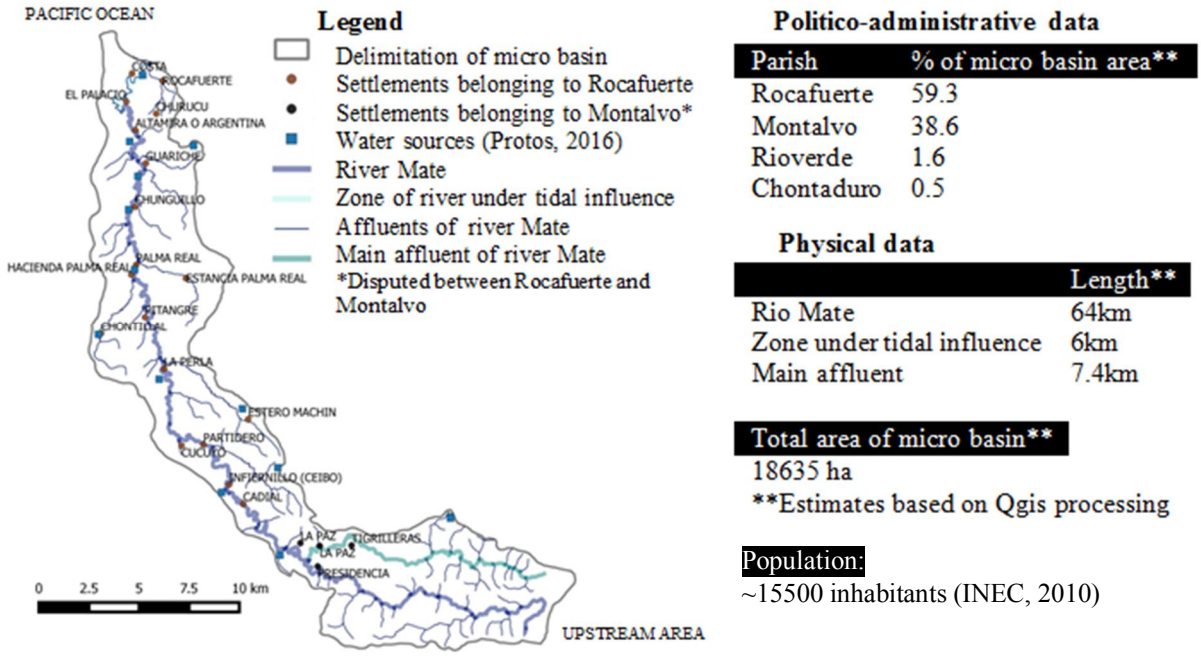

Figure 1: The micro basin of Mate (basin delimitation by author, shapes from INEC, 2010)

Theoretical framework and methodology: concerted approach to integrated water resource management in relation to action-research Although action in itself brings understanding and the social setting cannot be reduced for study (Baskerville, 1999), the context must be understood as well as possible before implementing an action. Understanding the context is primordial in the case of IWRM as sustainable interventions depend on an interaction between the geophysical, the administrative-political and the social realities (Protos-CEDIR-Sendas, 2010). Therefore stakeholder analysis must be realized, taking into account power relations and collaborations in order to consider antagonisms, interests, governance, power and rights. According to Protos-CEDIR-SENDAS (2010) "*Experience shows that when you manage to boost the social territory it is relatively easier to take action in the other territories. While the administrative-political territory is where sustainability and institutionalization of experiences is guaranteed, this implies to perform political advocacy."* This explains why an approach of concerted management is used, which is based on participation, democratic and transparent governance and strengthening of the actors. This is facilitated by Protos' extensive experience in the region on water and sanitation and by participation in local and national platforms around water. Together with water users, impacts are identified and actions are proposed, involving actors at different levels, individuals and organizations (such as associations) and public bodies at local, regional and national level. Application of a participative approach in which inhabitants and other actors of the water basin are consulted and involved in decision making, allows: i) recollecting information for the setting up of a reality-based diagnostic and micro basin management plan, including local interests, perception and culture ii) raising awareness about environmental issues and the different explanations of causes and influencing factors behind and iii) creating a basis for implementation of actions through participatively identified measures, allowing for a greater ownership, provided that the main conflicts, contradictions and power asymmetries can be considered and dealt with. These factors should allow increased sustainability of actions. Throughout the process different methods were applied (Figure 1), the methodology is inspired on

Dourojeanni (2001) and previous work of Protos on integrated water resource management (Protos Ecuador, 2014; Protos-SENDAS-CEDIR, 2012).

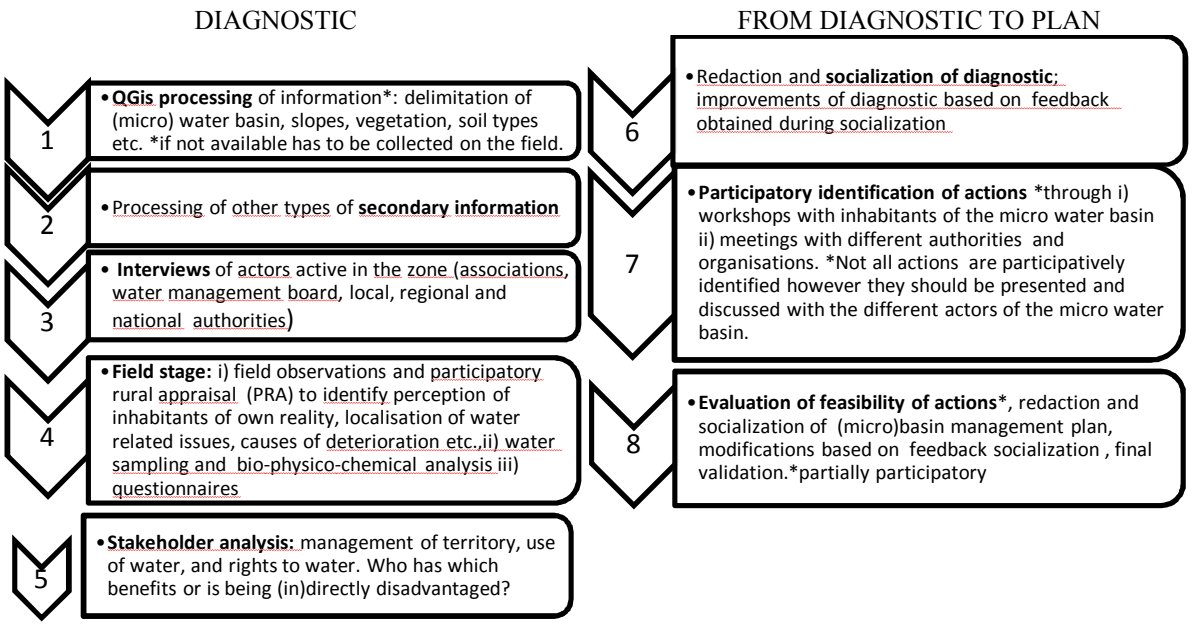

Figure 2: Realization of micro basin management plan

The water basin was delimitated approximatively based on contour lines from MAGAP-IICA-Clirsen (2002). PRA was performed in five different settlements to allow a maximum of participation because mobilisation, especially during wet season is difficult. Invitation to workshops happened through radio announcements, personally inviting participants and through key persons such as local leaders. Twenty questionnaires were filled in; the option was given to respond orally. Respondents were targeted through purposive sampling; members of the NAAT (agricultural association) were selected. The questionnaires served as means of confirming tendencies observed during PRA and the sample is clearly not representative. Interviews, PRA and questionnaires took place between December 2015 and August 2016 and awoke interest amongst participants.

Sources of deterioration Figure 3 depicts sources of deterioration of the micro water basin, which can be categorized in three types of activities. Lack of access to basic services is illustrated by the less than 1% coverage concerning public sewage (INEC, 2010) and waste treatment services reaching no further than Chunguillo and being irregular in the covered area, leading inhabitants to dispose their waste in nature (PRA). Concerning productive activities, expansion of livestock holding at the expense of the forest is a common phenomenon in developing countries (e.g. Lindtner in process). In the micro basin of Mate this is of particular concern due to strong slopes (Figure 4 and 5). There are more than 15680 units of cattle (NAAT, 2016) in the micro basin; this contributes to erosion, linked to slopes and worsened by overgrazing due to lack of rationalization of production systems, but also directly to water contamination caused by lack of drinking troughs. The latter implies most of the animals drink and bathe in the river and its tributaries. Only 3 farmers in the entire micro basin are reported to have a drinking trough (interviews NAAT, MAGAP) which explains the statement *"In summer the tributary [of Chontillal] turns green"* (PRA). Wood logging, particularly at the edge of water sources contributes to disruption of the hydrological cycle. Of particular concern is that logging is still proceeding in the upstream area which is crucial for water catchment and has a high prevalence of native forest (Figure 4). A major problem in term of water conservation

is that despite existing legislation (Asamblea Nacional, 2014) logging preferentially takes place at the edges of rivers and streams since they are suitable for plantation of crops such as banana (PRA). Finally, Figure 3 evidences that some activities which contribute to deterioration of the basin are linked to a lack of awareness, for instance, cleaning of pesticide spraying devices directly in the river. These elements are very similar to the ones affecting the adjacent basin of Rioverde where big scale palm *(Elaeis guineensis)* plantations cause additional problems (Rojas et al., in process).

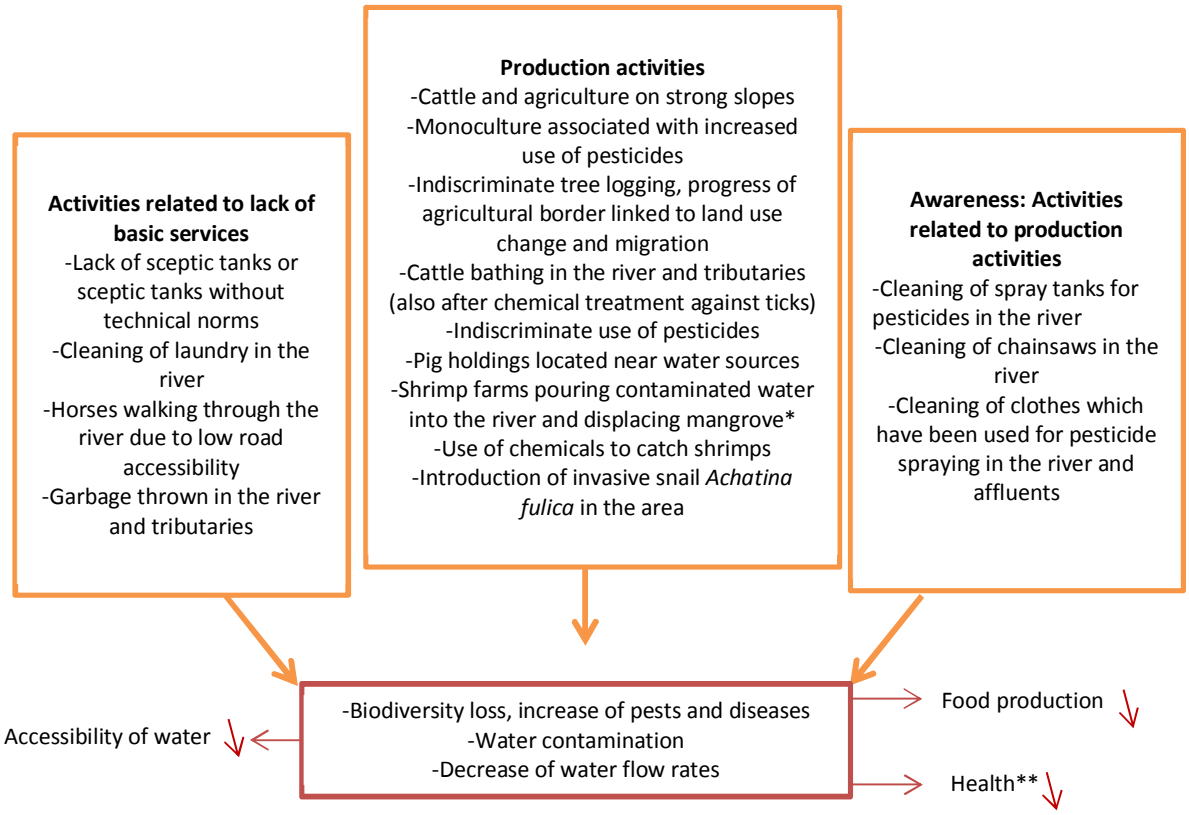

Figure 3: Sources of deterioration and consequences as identified by inhabitants (PRA)

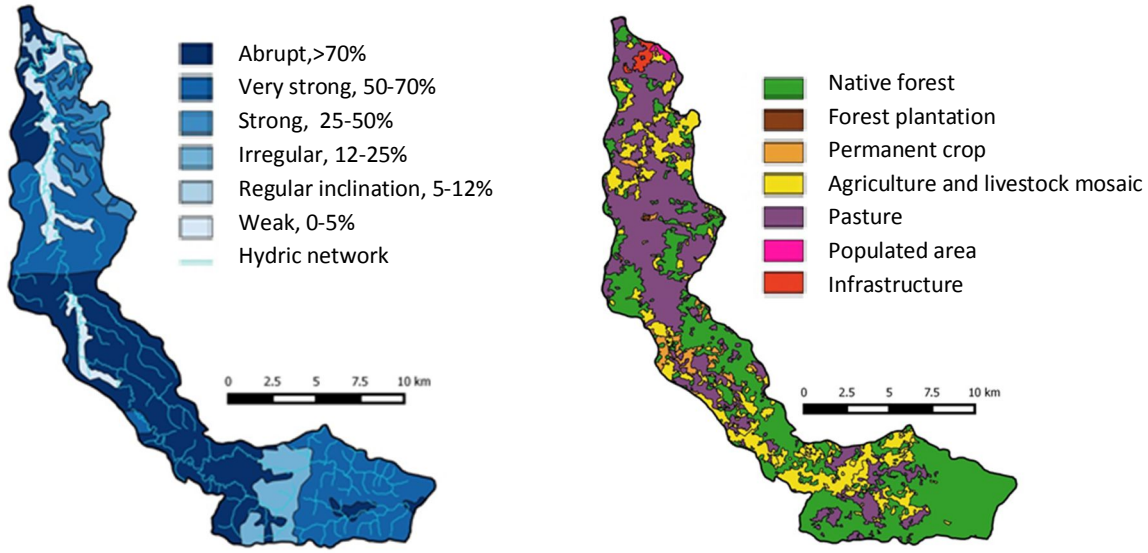

Figure 4: Slopes (rights) and land use (Figure made by author with data of MAG-IICA-Clirsen, 2002)

Figure 5: Settlement Presidencia (location on map see Figure 2); deforestation, pasture and signs of erosion.

Consequences Figure 3 illustrates consequences of deterioration. The health subcentre of Rocafuerte which attends inhabitants of the whole basin, reports that more than 20% of the daily identified diseases (amongst other piodermitis, diarrheal diseases, yellow fever, hepatitis A) are related to contaminated water (interview director subcentre and data facilitated by Ministry of Health). Disruption of the hydrological cycle has visible consequences (PRA, observations). In dry season inhabitants are directly affected by decreasing water flow rates as some water sources dry out and they have to walk large distance to get access to water (PRA). In some households this also implies increased reliance on bottled water which can cost up to 1 dollar per liter (which is high in proportion to the monthly basic income of 366 dollars [2016]). On the other hand in winter inundations are becoming more frequent (PRA) and landslides occur on deforested slopes (PRA, observations; in Altamira at the start of the year houses had to be evacuated following a landslide). With climate change these tendencies are likely to increase as Esmeraldas is highly vulnerable to climate change (Intercooperación, 2016). Finally, food production and sovereignty is threatened by deterioration of the microbasin. Cattle health is affected by low water quality (manifested by systematic use of antiparasitics), this contributes to explain low milk productivity (interview MAGAP). Moreover, decreasing water accessibility and drying of pasture in summer lead to cattle starvation (PRA, interview MAGAP and NAAT). Furthermore, inhabitants report it has become more difficult to grow amongst other short cycle crops due to increased incidence of pests (PRA) which can be related to decreasing biodiversity and introduction of invasive species. Decreasing biodiversity and fragmentation of habitats as well as overhunting linked to increasing population have caused a decrease in wild animal stocks (PRA; GADP Rocafuerte, 2015). "*Before we had food in abundance, both from the river and the mountain… because we had forest… Consumerism is killing us*" (PRA, Altamira)

Drivers Looking at changes between 80's and nowadays we notice rapid changes have taken place in the micro basin (Table 1). There has been a switch from subsistence to increasingly market-oriented and dependent livelihoods. This has been co-driven by policies targeting productivity in the 70's-80's, namely a credit scheme of the Banco de Fomento (currently BanEcuador) which promoted introduction of cattle, regardless of adequacy of soils, and of pesticides in the zone (PRA). Additionally, by market demand; particularly for wood. The high demand for wood is reflected in

data on legal logging (MAE, 2015), 33.8 % of the wood logged from native forests of entire Ecuador comes from the province of Esmeraldas (MAE, 2015 p.9; percentage in term of approved volume), with this rate it is the province with the highest rate of legal deforestation. When looking at logging from 'pioneering and natural regeneration formations' Esmeraldas represents 60% of approved volumes of all Ecuador (MAE, 2015, p.10). Moreover, the Ministry of the Environment (MAE) acknowledges ongoing illegal deforestation (interview). (See also Sierra, 2013) Logging to satisfy important market demands was only made possible through introduction of chainsaws, which leads us to another driver of change: technology.

Table 1: Changes in the micro basin from the 80´s until now (PRA, questionnaires)

Around the 80´s	***Nowadays***
Logging of wood for cooking and construction of housing, use of axes for logging, occasionally based on an order from outside *"In the 80's trees were logged with axes, it was really hard, sometimes it took an entire day for one tree." "There were mingas* to take down trees. With 2-3 axes at the same time, we managed to topple them"* (PRA Presidencia)	Logging of wood for sale primes over logging for local consumption (middle man play an important role), axes replaced by chainsaw "*When the chainsaw was introduced everything changed completely"* (PRA Presidencia)
Limited amount of population upstream of Altamira	Zones more inward colonized, facilitated through increase accessibility [roads by logging companies]
Agriculture and fishing for subsistence	Importance of agriculture directed toward commercialization with higher quantities of cattle and increasing importance of cacao cultivation, but also of crops new to the area such as passion fruit. Decreased amount of crops grown for subsistence, namely of short cycle crops. 19 Out 20 respondents of the questionnaires indicate a decline in diversity of the crops they grow and in quantity of food produced for auto-consumption
Organic agriculture based on mingas*	Use of agrochemicals, no evidence of knowledge of dosifications (few persons report they had a training on their use) *"In the 90´s people got used not to sow as before [i.e. without chemicals], but with poison instead. The people would stop to use workers, it would turn out cheaper for them with the poison.*" [interview inhabitant Rocafuerte]
Local production and consumption	Consumption of products from unknown origin which come with different types of packaging; introduction of increasing amounts of litter
Cleaning with black soap	Cleaning with strong chemicals e.g. chlorinated products such as bleaches

*Mingas are social gatherings to perform tasks such as weeding and planting

The switch from subsistence to increasingly monetary-income driven livelihoods was only possible through higher market accessibility, linked to construction of roads in the area. The first inhabitants of Presidencia report that it used to take them two days back and forth to go to the nearest village where they would only buy a limited number of items such as rubber boots and machetes, *"the most necessary things for the countryside"* (PRA). This is in strong contrast with the current situation in which inhabitants report buying a substantial part of their food (questionnaires, triangulated with PRA and participant observation). Improved access also facilitated migration which contributed to clearing of new areas (PRA). This amelioration of accessibility is relative; in winter time accessibility upstream of La Perla is still poor due to non-paved roads and presence of montmorillonite soils which swell with the rain; this leads to frequent losses of harvests related to the impossibility to get goods to the market (PRA, GADP Rocafuerte 2015).

The changes in the micro basin have occurred without adequate counterbalancing measures to guarantee conservation of the micro basin which can be linked to lack of i) prioritization and

transversal focus ii) human and financial resources iii) coordination and collaboration; different elements point at a weak governance capacity. For instance, the Ministry of Environment has not been able to counter deforestation managing the SocioBosque reforestation programme in the basin together with local authorities. Reforestation of the accessible downstream areas has been implemented and faces challenges while no conservation is ongoing in the upstream area, which is key for water and biodiversity conservation (interviews, PRA). Or as a resident of Presidencia said *"They should give us an incentive to take care [of the forest], not to plant, there's pure forest left".* Additionally, nowadays cattle is still ranked as a Category I activity in the national system for environmental information (SUIA), which implies livestock holding is not subject to any (environmental) criteria.

Sustainable livelihoods? Referring to Scoones (1998) we reflect shortly on livelihoods' sustainability; the results show a decrease in resilience of livelihoods due to deterioration of the micro basin in terms of water, soils and biodiversity. The increase in economic capital, manifested through increase in assets such as televisions, solar panels, spraying devices and chainsaws (PRA, observations), is strongly reliant on extractive activities and thus at the cost of natural capital. "*Our grandchildren won't be able to see guayacanes, seen how we knock them down*" (PRA, La Perla) illustrates this. Despite the Plan Nacional de Buenvivir which advocates a switch from extractive to value adding activities (SENPLADES, 2012) little of this switch is visible in the micro basin. Moreover, results point at a decrease of social capital, evidenced by the decrease in mingas (Table 1). Concerning human capital, education centred policies have improved this aspect, however remoteness of upstream areas and limited accessibility worsened by the centralization policy of the Correa government imply limited attendance to especially high school education of persons living more upstream of La Perla. This also contributes to disruption of social tissue since some parents migrate to more urban areas in order for their kids to get access to higher education (PRA).

Recommendations The integrated water management plan of the micro basin proposes a series of actions in collaboration with different actors active in the area (Herman et al., 2016) focusing on raising awareness and sustainable production, however punctual actions are not sufficient to tackle bigger ongoing processes. There is for instance a need to address livestock through impact recategorization; sustainable livestock production systems also offer opportunities in terms of valorisation of manure. Moreover, there is a need to increase synergies between actors through collaboration to handle challenges despite the economic crisis. Promoting environmental sustainability as a transversal criterion of action within the different authorities would be an important step toward improving the situation. Currently the segregation of competences within different authorities does not promote sustainability of actions. Further, an important issue to address is prioritization of zones for conservation in the SocioBosque programme as the upstream area is key to water recharge, and the remaining native forest should be declared protected area. However, extractive activities will only decrease if an alternative is available and accepted, therefore value adding activities such as inclusion in cacao certification schemes which offer a premium and processing activities such as production of cacao paste should be impelled. To limit progression of the agricultural frontier in the upstream area and conserve humidity, cacao could be promoted as an alternative to livestock since inhabitants manifested interest but lack of knowledge in cacao production. There is also work to be done to balance power asymmetries and conflicts between producers and intermediaries, the latter having a high bargaining power and producers being little organized to confront them. Finally, improved road accessibility can be seen both as an opportunity

and a threat; on one hand it could lead to higher diversification of production for markets if farmers are better coordinated with markets; on the other hand to increased deforestation.

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