

**Developing markets
for watershed
services and
improved livelihoods**



Fair deals for watershed services in Bolivia

Nigel Asquith
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Acronyms and abbreviations

AdT	Aguas del Tunari
AULL	Association of Users of the Larati Lagoon
CIAT	Centre for Tropical Agricultural Research
DFID	Department for International Development (UK)
FAO	Food and Agriculture Organisation
GDP	Gross domestic product
ICO	Eastern Training Institute
IIED	International Institute for Environment and Development
IWM	Integrated watershed management
NGO	Non-governmental organisation
PES	Payments for environmental services
PWS	Payments for watershed services
SEARPI	Pirai River Flood Channelling and Control Service

Preface

Bolivia is a country divided. Two cultures, two world-views and two economic models split the country almost exactly in half. The western high plains (altiplano) and mountains are home to the Aymara and Quechua-speaking indigenous groups, who govern water using traditional models of community management. In the desert-like altiplano, efficient water husbandry is a matter of survival. Community-based water management responsibilities and rights are integral to the Andean cosmovision: the mix of social, economic, cultural and historical factors that shapes an individual's relationships with the world. In the Andes, water is a gift from the earth goddess Pachamama and it is the responsibility of all to husband this gift, and the right of all to use it. The government of Evo Morales is revolutionising community natural-resource management models, nationalising all of Pachamama's gifts: oil, gas, forests, biodiversity and water. "Every drop of water is the property of the state, and the state shall decide how it is used"¹. On the other hand, nationalisation reflects more than 500 years of paternalistic culture, in which the common man has looked to the Inca, to the conquistadors, the elite, and to the dictator and patron to impose authority. In the newly centralising Bolivian economy there are decreasing options for local decision-making, and little space for local watershed management.

In the "half moon" of the lowland departments of Tarija, Santa Cruz, Beni and Pando the outlook is rather different. Forty years ago, Santa Cruz de la Sierra was still a tree-lined plaza bounded by dirt roads. Now a city of 1.3 million, it is the economic motor of Bolivia. The Departments of Santa Cruz and Tarija hold 93% of Bolivia's oil and gas reserves, and Santa Cruz provides 30% of Bolivia's gross domestic product (GDP) (www.ine.gov.bo). A mercantile, individualistic culture holds sway: the most appropriate comparison is with the American Wild West. Countless fortunes have been made and lost in the Santa Cruz boomtown since the 1950s: timber, coca, oil, cattle, and now soy and sugar. Brazilian cattle ranchers do business across the river from Acre or arrive on direct flights to Santa Cruz from Mato Grosso do Sul. As Santa Cruz's resources have been nationalised by the Bolivian state, there has been increasing questioning of the extent to which the resource-rich east should subsidise the highlands. In 2005, for the first time, Bolivia's Departments voted for their own regional governments. In July, the green and white flag of Santa Cruz flew over more than half a million demonstrators agitating for autonomy. When the heads of the "half moon" Departments met

1. Vice Minister John Gomez, IIED-supported workshop in La Paz, 18 September 2006.

in September 2006 to discuss the increasingly tense situation, President Morales declared that even holding such a meeting was illegal.

It is in this context that Fundación Natura Bolivia undertook an assessment of whether market mechanisms for watershed management can improve rural livelihoods. It should be clear from this preface that the answer to this question depends on which part of schizophrenic Bolivia is being analysed: the Bolivia of Evo Morales, or the Bolivia of the mercantilist lowlands.

Executive summary

Despite numerous attempts at integrated watershed management in Bolivia, there have been few successes. Projects have invariably focused on increasing or managing supply through dam and infrastructure construction, and have rarely focused on improving efficiency or managing demand. At the national level, management has usually been through top-down laws and regulations, few of which have succeeded. Although Bolivia is one of the countries with the most water per capita in the world, and demand is about 1% of supply, localised water scarcity continues to breed conflicts.

In much of Bolivia, relatively poor irrigators already pay monthly or annual quotas to maintain irrigation infrastructure and ensure water supplies. Thus there is an apparent paradox. On the one hand, indigenous Bolivians purportedly view water “as a universal and communal right (that) should be distributed equitably according to needs, traditions and community norms that respect the water cycle” (pre-diagnostic report 23). On the other hand, communities from Incahausi to Tiquipaya have endogenously developed trustworthy mechanisms by which they buy and sell their water rights. Notwithstanding the official “party-line”, market-like watershed management tools – often developed through local, traditional mechanisms – have long been used in Bolivia.

As part of a multi-country project coordinated by the International Institute for Environment and Development (IIED), in 2004 Fundación Natura Bolivia initiated an analysis of whether market mechanisms for watershed management can improve rural livelihoods in Bolivia. This analysis was designed to assess the social, political, economic and biophysical context and history of the country, and to assess if and how – given this context – market tools or market-like incentives could be used to improve watershed management, and to improve incomes and livelihoods of watershed residents.

Nine lessons for negotiating Fair deals for watershed services in Bolivia

- 1) Market mechanisms for watershed management can improve rural livelihoods, though the most significant impacts are likely to be indirect, rather than the actual payments. Meanwhile, the poor bear high costs for inefficient water management.**

In one example, upper watershed landowners in the Los Negros valley have been invited to voluntarily enter a payments for environmental services (PES) programme that pays the equivalent – in beehives or barbed wire – of up to US\$3 per hectare per year for native vegetation protection. Although the direct impacts of the transfers in Los Negros have thus been small, the indirect effects of the PES scheme have been larger and more generally positive. There are now four functioning “environment committees” in the watershed, and an Association of Beekeepers has been formed. Elsewhere in Bolivia, it is often the poor who bear the highest costs for water. Small-scale (10–15 m³ per month per family) untreated water for domestic use varies in cost between US\$0.1–0.2 per cubic metre. In contrast, subterranean irrigation water costs US\$0.01–0.05 per cubic metre.

- 2) Central government has little impact on either promoting or precluding market-based mechanisms for watershed management and improved livelihoods.**

Bolivia’s fundamental water law is still based on an 1879 Decree. Numerous attempts have been made to update and adapt this law, but proposals to change the rules of watershed management are in legal gridlock. Central government is so short of resources that it has little reach into many of Bolivia’s more remote watersheds. Local institutions and mechanisms have often had to develop to fill the gap left by central government. For example, markets for irrigation rights have developed endogenously in areas such as Chimboco, in the Sacaba valley. Several of the water users’ unions, such as the 960-member Association of Users of the Larati Lagoon (AULL) even serve as *de facto* local government.

- 3) There are few locations in Bolivia where payments for the maintenance of water quantity may work socially, economically and biophysically.**

Given the *biophysical* and *socioeconomic* reality of Bolivia’s watersheds, market-based mechanisms for maintaining water flow are likely viable in only a few sites. Biophysical and socioeconomic selection criteria show that only 37 sub-watersheds may be apt, whereas more localised analysis suggests that market-based mechanisms for managing dry-season water quantity and quality may be feasible in only ten Bolivian watersheds. The potential for management of water flows using incentives for land-use maintenance geographically is thus geographically extremely limited in Bolivia, and will likely be so elsewhere.

4) Decentralisation has allowed local control of natural resource management that can facilitate local development of market mechanisms.

Bolivia's decentralisation law (the law of Popular Participation) was part of a package of reforms designed to make public investment more efficient. Responding to the need to decentralise the administration of health, education and road services, the government opted for making municipalities governing entities autonomous from central government, with their own budgets and power to take decisions within the municipality. Bolivia's municipalities thus now have some degree of the authority, and some of the funds to manage the natural resources, such as forests water and wildlife, that lie within their borders.

5) Formal or legal property rights are so rare in Bolivia that investors must often work with *de facto* rights holders.

A lack of formal government-approved property rights is a fact of life in rural Bolivia. So locally developed institutions have assigned and recognised land rights and disconnected water rights. This was done in Tiquipaya by local farmers' unions who designed a system based on how much water had historically been received by each irrigator. Watershed services cannot be bought and sold if it is not known who owns them. Implementers of market-based management initiatives must therefore work within the locally developed *de facto* property rights system rather than waiting for the development of a *de jure* property rights system.

6) Large-scale watershed management projects in Bolivia have traditionally been top-down, led by outsiders, and have failed. Successful market-based schemes must likely be developed locally.

Integrated watershed management (IWM) projects in Bolivia have generally failed. For example, in the Pilcamayo and Bermejo watersheds, international donors have invested tens of millions of dollars, and the problems of erosion, desertification and pollution in the watershed have not been resolved. Meanwhile, institutional strengthening has not continued after the projects have finished. If watershed management is to be successful in Bolivia, managers must recognise that social processes will ultimately determine the sustainability of an intervention, and that long-term results should be the focus when developing strategies.

7) Given the lack of trust in institutions, market-based mechanisms for watershed management and improved livelihoods schemes will likely only work when people have trust in each other (this suggests small-scale).

The Bolivian government has historically had little rural presence. External development interventions have often failed, with much of the projected resources never reaching target communities. Building trust thus appears to be the most critical component in ensuring the sustainability of initiatives. Existing examples of

incentive-based watershed management have developed endogenously with little outside involvement: similar schemes may work best when they take advantage of local mechanisms for project design, implementation and uptake, and explicitly address trust building.

8) Extensive, long-term history of successful, market-like initiatives for watershed management in Bolivia can provide models for action and discussion.

Market-like mechanisms have supported watershed management in Bolivia since pre-colonial times, governed by long-standing, locally developed rules and regulations. Bolivian grass-roots institutions thus already have extensive experience managing market-based mechanisms for watershed management. External interventions can – and must – therefore build on this existing capacity rather than reinventing institutions and trying to create new mechanisms.

9) There is extremely low capacity for innovative thinking about watershed management, so further development of successful market-based initiatives will require significant outside investment in human and financial resources.

Market mechanisms for watershed management will only work if they are developed with high levels of local involvement. Currently, the greatest bottleneck in the process is the lack of human capacity for designing incentive-based mechanisms for watershed management both inside and outside Bolivia. The most cost-effective donor investments will be in building local capacity to design and manage projects, and in training in adaptive management and critical thinking.



1. Introduction

As part of a multi-country project coordinated by IIED, in 2004 Fundación Natura Bolivia initiated a three-stage analysis of whether market mechanisms² for watershed management can improve rural livelihoods in Bolivia. The purpose of IIED's international project was "to increase understanding of the role of market mechanisms in the provision of watershed services to improve livelihoods". The analysis of Bolivia was designed to assess the social, political, economic and biophysical context and history of the country, and to assess if and how – given this context – market tools or market-like incentives could be used to improve watershed management, and to improve incomes and livelihoods of watershed residents.

The first stage of the project was a pre-diagnostic analysis that comprised a participative literature review by academics, government officials and non-governmental organisations (NGOs), which led to the presentation of a series of documents at two meetings: "*Experiences of Compensation for Environmental Services Provided by Ecosystems: The Case of Water*" held in Santa Cruz in October 2004; and "*Improving Bolivian Water Management: Incentives to Promote Sustainable Watershed Management that Improves Rural Livelihoods*" held in La Paz in November 2004. The question addressed in these meetings was whether market mechanisms could usefully be applied in Bolivia to both protect the environment and reduce poverty. For ease of analysis this question was divided into two components:

- What is the current context in Bolivia for watershed management?
- What is the case in Bolivia for market mechanisms for the provision of watershed services that improve livelihoods?

The pre-diagnostic raised more questions than it answered. Preliminary evidence suggested that notwithstanding what we had understood to be the Andean cosmovision, Aymara indigenous groups had for centuries managed their watersheds

2. In this paper we use the terms "market", "market-based" and "incentive-based" mechanisms for watershed management interchangeably. We define such mechanisms as voluntary, contingent *quid pro quo* transactions around a well-defined hydrological service (or a service-producing land use) (cf. Wunder 2005). Such "markets" usually involve few players, and are often based on negotiations, sometimes through an intermediary, between the buyer and sellers. We are thus not referring to anonymous markets for bulk commodities, but rather, simple mechanisms by which people respond to price or economic signals. Our use of the term "market-like" refers to mechanisms that while not including *quid pro quo* conditionality do have some degree of reciprocity, e.g. upstream landowners ensure that there is water in the stream whereas downstream water users agree to help in the harvesting of upstream crops.

though community cooperation compacts that had important market-like components (14)³. On the other hand, investments by international donors in integrated watershed management projects had rarely, if ever, succeeded. Market mechanisms have never been used to manage watersheds in Bolivia (Robertson & Wunder 2005). However, the country has been an innovator in natural-resource management, having hosted the first ever debt-for-nature swap in the Beni and the pioneering US\$10 million Noel Kempff Mercado carbon sequestration project (Asquith *et al.* 2002), and having one of the world's most environmentally progressive forestry laws (Boscolo & Vargas 2001). How can Bolivia manage its natural resources in such an eclectic, even schizophrenic way? A second phase of research tried to address this question related to water. Twenty-one reports were commissioned (see Annex 2) ranging from an assessment of the legal history of Bolivian water use (1) to an in-depth analysis of the potential for payments for watershed protection in the Pirai watershed (21). The present report focuses on the interpretation of these papers.

The third phase of the project, co-supported by other donors, was to undertake a holistic diagnostic to show how these data and information can be used to develop a national, or at least regional, incentive-based watershed management model, using Santa Cruz's Rio Grande watershed as a case study (22). Finally, the Bolivian partners and IIED developed an information dissemination process to explain the significance of project findings, and to invite high-level political leaders and innovators from other countries, such as Ecuador, Brazil and Costa Rica, to visit Bolivia to comment on, and add to, the project's results⁴.

3. Numbers in parenthesis relate to commissioned reports listed in Chapter 2 and Annex 2.

4. For example, CIFOR Senior Economist Sven Wunder presented other countries' experiences with incentive-based watershed management to audiences in La Paz and Santa Cruz in May 2006, whereas Pablo Lloret (FONAG, Quito) and Robert Yaguache (CEDERENA, Loja, Ecuador) did the same in September 2006.



2. The major categories of reports commissioned for the project, what they were intended to assess, and their general findings

2.1 There were five major categories of commissioned reports

a) Policies, laws and institutions (reports 1–3, 8)

These reports were commissioned to assess the legal and institutional status of water management. The profound changes in government that occurred during the project complicated such analyses and made some of them redundant, but if anything these changes served to highlight the major conclusion: Bolivia is not a country that can or should be governed from the centre (see also Contreras & Vargas (2001); Pacheco (2004)). The reports describe the confusion that reigns at national level about which institutions, laws, norms and regulations are relevant and useful, and who actually has the right to develop watershed management policies.

b) Watershed hydrology and site selection criteria (reports 4–7, 25)

These reports assessed the state of hydrological knowledge at a national, regional and watershed level. The conclusion is that so few data exists that it is hardly useful. Researchers and project implementers must go out and collect data for themselves, or undertake modelling exercises as we were forced to do in Los Negros and Quirusillas.

c) Experiences: how has Bolivia managed its watersheds (reports 9, 13–16, 24, 26, 27)

Building on anecdotal evidence from the pre-diagnostic phase, these reports assessed Bolivia's experiences in integrated watershed management (IWM) in two watersheds, traditional management schemes in two watersheds, and collated up-to-date information on experiences with market mechanisms. Conclusions were that donor-led IWM has usually failed (top down, outsider led, with little link to real needs), market-like mechanisms have traditionally been used throughout Bolivia, but the current crop of NGO-led market-like initiatives are finding it difficult to build local confidence that such schemes really can help the poor.

d) The socioeconomic reality of Bolivia's watersheds (reports 10–12, 17, 23)

These studies were commissioned to describe the socioeconomic situation in watersheds where market-based management schemes are most likely, biophysically speaking, to succeed. The reports showed that these watersheds are characterised by unclear, or at least undocumented, land tenure, high levels of poverty especially in the upper watersheds, a total dependence of downstream users on upstream water sources, replacement of locals who are migrating out of the watersheds by immigrants arriving from other areas, highly complex, locally evolved decision-making structures, and a high dependence of farming and extensive cattle raising for income.

e) Case studies (reports 18–22)

The case studies (Los Negros, Quirusillas, Comarapa, Pirai and later Rio Grande) were selected based on a series of rigorous biophysical and socioeconomic criteria (4, 5). As these watersheds are all in the same bioregion and they are geographically close to one another, their socioeconomic situations were similar. Service users (and potential payers) range from small-scale irrigators in Los Negros, a dam in Comarapa, the 1.5 million inhabitants of Santa Cruz in the Pirai, and large-scale soy farmers in the Rio Grande. Upstream, the watersheds are more similar than different: humid forest threatened by small-scale agriculture and extensive cattle grazing, very poor farmers, and a very low opportunity cost of conservation. Before this research project, Fundación Natura Bolivia was already developing a payments for watershed services project in Los Negros. As a direct result of the case studies and subsequent meetings with the communities, Fundación Natura Bolivia has been invited by the municipalities of Quirusillas and Comarapa to develop similar initiatives, and by the municipality and prefecture of Santa Cruz to develop plans for market-based management of the Pirai and Rio Grande watersheds.



The threat to Bolivia's water supplies – deforestation of water-producing cloud forest



3. Lessons learned from the project

Despite numerous attempts at integrated watershed management in Bolivia, there have been few successes (15, 16, 21, 24). Projects have invariably focused on increasing or managing supply through dam and infrastructure construction (16), and have rarely focused on improving efficiency or managing demand (24). At the national level, management has usually been through top-down laws and regulations, few of which have succeeded (1). Although Bolivia is one of the countries with the most water per capita in the world, and demand is only about 1% of supply, localised water scarcity continues to breed conflicts (25). Irrigated agriculture accounts for 80% of Bolivia's water demand yet irrigators pay low water tariffs, often less than 1% of what the peri-urban poor pay (27).

In much of Bolivia, relatively poor irrigators already pay monthly or annual quotas to maintain irrigation infrastructure and ensure water supplies. Such quotas can be in cash (as in Comarapa (18) and Quirusillas (17, 19)) or in labour (as in Los Negros (20)). The institutional context of such payments often involves irrigators' associations that in many cases have developed locally, but in some cases has been promoted or strengthened by international cooperation. In the municipality of Incahausi, after the building of new dams by international donors, many farmers received such irrigation rights for free. Though not the intention of the project, markets for these rights have developed endogenously, and farmers now buy and sell their water rights. Notwithstanding the fact that the original allocations of water rights were free, markets for what was a scarce resource quickly developed (13).

The Tiquipaya watershed supports several functionally independent irrigation systems, many of which were developed in pre-colonial times. Each of these systems has developed its own modalities (24), such as turns, which can be bought and sold, in cash or in kind. The crucial innovation in many of these systems is that resource users have the right to a fixed amount of water, and can use it for irrigating any of their plots (even those outside the system). In this way, the systems have disconnected the water/land relationship and thus separated land and water rights. This has allowed development of a market for water and has encouraged water owners to sell their rights to buyers such as residential users. Under extremely dry conditions, even complex inter-sectorial water transfers have been undertaken. For example one well-known agreement is between the Saytu Kchocha community and the SEMAPA water utility, through which SEMAPA compensated Saytu Kchocha for its extraction of drinking water through investments in local system improvements (24).

The Cochabamba water war

The valley of Cochabamba is a highly fertile and irrigated region: the breadbasket of Bolivia. The metropolitan area of Cochabamba, however, is proliferating and is expected to probably reach one million inhabitants by 2010. As a result, the aquifers in the area have been over abstracted. Additionally, the area has been struck by severe droughts over the past 30 years, exacerbating the competition for the scarce resource between irrigators and the city.

Faced with increasing scarcity, a lack of capital and inefficient management, the concession to run Cochabamba's ailing municipal water company, SEMAPA, was handed over to Aguas del Tunari (AdT), a consortium that was a subsidiary of Bechtel Enterprises. When new higher tariffs negotiated between the government and AdT came into effect, criticisms of the contract were voiced and demonstrations ensued, causing the regulator to roll back the higher rates. Protests spread into other parts of the country, resulting in the cancellation of the contract (Bonnardeaux 2003).

Thus there is an apparent paradox. On the one hand, indigenous Bolivians purportedly view water "as a universal and communal right (that) should be distributed equitably according to needs, traditions and community norms that respect the water cycle" (23). On the other hand, communities from Incahuasi to Tiquipaya have endogenously developed trustworthy mechanisms by which they buy and sell their water rights. Notwithstanding the official party-line, market-like watershed management tools – often developed through local, traditional mechanisms – have long been used in Bolivia⁵.

Much of the fear around the use of incentives is based on the fiasco of the Cochabamba water war (Box 1) and the widespread sense that market-based mechanisms as promoted by outsiders signify privatisation and restriction of use by the poor, which is not necessarily the case. Indeed, the rejection of market mechanisms for watershed management by Bolivia's social movements is often actually based not on data or experiences, but on a philosophical questioning of the process of economic valuation of nature. There is also rejection of what many fear is the end point of a valuation exercise: requiring people to pay for ecosystem services, and the complementary result that people should be willing to accept compensation payments for environmental damage. According to its opponents, this limited accounting perspective of the value of natural resources enforces a focus on economic growth.

Environmental valuation certainly has its uses. However, it is important in the Bolivian context to analyse the political dangers that even undertaking such an

5. Perhaps it was only after economists started calling "markets" or payments for environmental services (PES) what had always been known as "reciprocal agreements", did the idea surface in Bolivia that it was socially unacceptable that incentive-based tools be used to support watershed management.

analysis creates, particularly if the valuation process is overly simplistic, ignores cultural sensibilities and non-market values and addresses only the market value of the resource. If discussions about market-like incentive schemes are to advance in Bolivia, proponents must significantly change the terminology being used, and, for example, stop referring to such schemes as “*payments* for environmental services”.

However, several case studies (e.g. 20, 26) show that there are opportunities for building on traditional experiences, and developing successful market-based mechanisms for watershed management. It appears that small-scale projects can be feasible in Bolivia regardless of political, legal and institutional winds (Robertson & Wunder 2004). If the price is acceptable to both parties, the idea has been widely disseminated and discussed, and landowners are comfortable with the idea, even theoretically insuperable problems, such as lack of government-approved tenure, can be overcome (20, 26).

3.1 Nine lessons for negotiating fair deals for watershed services in Bolivia

- 1) **Market mechanisms for watershed management can improve rural livelihoods, though the most significant impacts are likely to be indirect, rather than the actual payments. Meanwhile, the poor bear high costs for inefficient water management.**

In one example, upper watershed landowners in the Los Negros valley have been invited to voluntarily enter a payments for environmental services (PES) programme that pays the equivalent – in beehives or barbed wire – of up to US\$3 per hectare per year for native vegetation protection. As of October 2006, 34 landowners were protecting 2073 hectares of forest, of which about 1000 hectares were cloud forest, in contracts ranging from 1 to 10 years, and receiving about US\$5000 in direct payments. The scheme also has activity-enhancing effects that benefit some of the landless people in the valley. For example, some participants have sold beehives to landless people specialising in apiculture, thus creating an “intra-village secondary market” to exchange beehives for cash (Robertson & Wunder 2005), whereas other farmers are hiring landless community members to help with honey processing.

Even among PES participants, there are many moderately poor farmers. The transfer of a beehive as a physical asset has a corresponding cash value of US\$30, i.e. US\$3 per hectare. Independent of the size of enrolled land, PES participants have in addition received apicultural training, which measured by its costs corresponds to a gain in human capital of about US\$35 per participant. In practice, the returns to beekeeping have been extremely skill-dependent: not everybody in the village has been equally successful. Considering honey yields, labour requirements, the going wage rate and an expected lifetime of beehives of 15 years, the net present values



Payments for watershed services in Los Negros: Maria Teresa Vargas and a representative of the municipal government present a landowner with her barbed wire

of beehive transfers range between US\$15.25 per hectare per year (negative value) and US\$12.6 per year (Robertson & Wunder 2005). In other words, the most skilful and lucky beekeepers would make a return over 15 years that quadruples the value of the hive assets, whereas the less fortunate ones would make a considerable loss – meaning that their apicultural labour would be remunerated significantly below the going wage rate.

Although the direct impacts of the beehive transfers in Los Negros have thus been small and variable, the indirect effects of the PES scheme have been larger and more generally positive. In terms of social capital, there are now four functioning environment committees in the watershed and an Association of Beekeepers has been formed. Upstream – downstream tensions are lower, and cooperation has increased, as there is increasing recognition that watershed management is a problem that is everyone's, which must be solved cooperatively (Robertson & Wunder 2005; Asquith *et al.* in review).

Elsewhere in Bolivia, where efficient methods for allocating water have not been developed, it is often the poor who bear the highest costs. Small-scale (10–15 m³ per month per family) untreated water for domestic use varies in cost between

US\$0.1 and US\$0.2 per cubic metre. In the peri-urban areas around cities, where the poorest citizens tend to live, costs are much higher, up to US\$1.25 per cubic metre, or when using 200 litre containers US\$3.12 per cubic metre. Bottled water is even more expensive: US\$75 per cubic metre. In contrast, superficial irrigation water which wealthier landowners can access is much cheaper, varying between US\$0.005–0.03 per cubic metre, whereas subterranean irrigation water costs US\$0.01–0.05 per cubic metre (24). These numbers in themselves argue that a simple overhaul of water management practices has the potential to have significant pro-poor effects.

2) Central government has little impact on either promoting or precluding market-based mechanisms for watershed management and improved livelihoods, either directly, or through sectoral policies.

Bolivia's fundamental water law was based on an 1879 Decree that was elevated to law in 1906. Numerous attempts have been made to update and adapt this law, such that there now exist 32 versions of a new water law (1). Proposals to change the rules of watershed management are thus in legal gridlock (1). Central government is so weak and short of resources that it has little or no reach into many of Bolivia's more remote watersheds (2, 3). In some cases international cooperation has led the management of watersheds (15, 16) whereas in others, local institutions and mechanisms have had to develop to fill the gap left by central government (13, 14). Markets for irrigation rights have developed endogenously in Inchausi and in other areas such as Chimboco, in the Sacaba valley. Sacaba valley communities maintain their customary laws and have developed many innovative institutions to manage natural resources. Such associations are often entirely autonomous and self-managed; they generally have complex rules and norms that revolve around rights (often water rights are de-linked from land rights), responsibilities, and conflict resolution. Several of the water users' unions, such as the 960-member Association of Users of the Larati Lagoon (AULL), even serve as *de facto* local government. Anyone who wants to use water either for irrigation or consumption in the Sacaba valley must become a member of the users' association and assume all of the responsibilities that this implies. Current water distribution is based on rules developed in 1903, which were developed entirely independently of central or even regional government (Symantha Holben, personal communication).

Further, macroeconomic policies have essentially bypassed watershed management (10): most agricultural production in the mid-altitude highlands, such as the Santa Cruz valleys, where watershed PES has its greatest potential, is for domestic production. Exchange rates and trade policies thus have little effect on land-use change patterns. Meanwhile poverty-reduction policies implemented by the government and outsiders have had little impact on the small-scale agricultural sector (8). Internationally led attempts to manage watersheds have generally

responded to donor interests rather than to central government's needs or local needs. Given the importance of locally developed initiatives, the independence of donor investments, and the lack of reach of the state into rural areas, central government thus has had – and will likely continue to have – little impact on promoting or restricting market mechanisms for watershed management (cf. Contreras & Vargas 2001; Pacheco 2004).



Water from the cloud forest helps support Bolivia's agriculture

3) There are very few locations in Bolivia where payments for the maintenance of water quantity may work socially, economically and biophysically.

Given the biophysical and socioeconomic reality of Bolivia's watersheds, market-based mechanisms for maintaining water flow are likely viable in only a few sites. Biophysical and socioeconomic selection criteria show that only 37 sub-watersheds may be apt (4), whereas more localised analysis (5) suggests that market-based mechanisms for managing dry-season water quantity and quality may be feasible in only 10 Bolivian watersheds⁶. Hydrological and socioeconomic analyses in five of the selected watersheds highlighted the difficulties of designing and implementing initiatives even in these sites (6, 7, 17–22). The potential for managing water flows using incentives for land-use maintenance geographically is thus extremely limited in Bolivia, and is likely to be elsewhere also.

4) Decentralisation has allowed local control of natural resource management that can facilitate local development of market mechanisms.

Bolivia's decentralisation law (the law of popular participation) was part of a packet of reforms designed to make public investment more efficient. Critically important was the goal of including actors who had traditionally been marginalised, including indigenous peoples and subsistence farmers. Responding to the need to decentralise the administration of health, education and road services, the

6. See Annex 1 for more details about the site categorisation process.

government opted for “municipalising” the country, making municipalities governing entities autonomous from central government, with their own budgets and power to take decisions within the municipality (2, 3). Municipalities are now responsible for water supply and sanitation and could be the buyers of watershed management services. The National Dialogue Law distributes funding to each of the country’s municipalities according to the number of inhabitants and its poverty index. Of these funds, 70% were destined to finance municipal productive infrastructure and social projects. Bolivia’s municipalities thus now have some degree of the authority, and some of the funds to manage the natural resources, such as forests water and wildlife, that lie within their borders. Although difficult, there is thus an institutional structure in Bolivia that facilitates direct negotiations between project designers and local government. However, technicians are often poorly trained, and even senior municipal decision makers lack capacity for natural resource management. Moreover, staff turnover is high, meaning that trained technicians often leave before their training is complete (12). Despite these difficulties, working through local government is likely to be the most effective – and perhaps the only – way of promoting market mechanisms for watershed management in Bolivia (2, 3, 12, 20). For example, municipalities could act as buyers of locally produced watershed services for domestic water supplies. Alternatively, municipalities could facilitate between landowner sellers of watershed services and private sector buyers such as irrigators.

5) Formal or legal property rights are so rare in Bolivia that investors must often work with *de facto* rights holders.

The one central government action, or rather lack of action, that has the potential to affect the development of market mechanisms for watershed management is the failure to assign and protect property rights (11). However, a lack of formal government-approved property rights is a fact of life in rural Bolivia, and so locally developed institutions have assigned and recognised land rights (11) and disconnected water rights (13, 14). This was done in Tiquipaya by local farmers unions who designed a system based on how much water had historically been received by each irrigator. It is clear that watershed services cannot be bought and sold if it is not known who owns them. Implementers of market-based management initiatives must therefore work within the locally developed *de facto* property rights system rather than waiting for the development of a *de jure* property rights system (cf. Umbeck 1977). Basing such initiatives on local rights is possible (20), and often preferable, as it recognises local decentralised authority (2, 3, 20). For example in the upstream communities of the Los Negros valley, few landowners have government-approved title, but rather rely on signed purchase contracts as proof of possession. Such proofs are commonly accepted for plots that are actively managed. The strategy of the PES project in Los Negros has been to

recognise such *de facto* claims, as long as the landowner's neighbours support them. For participants of this PES scheme, *de jure* rights have not been required. However, such a strategy probably limits projects to the smaller scale at which the *de facto* rights are recognised and where transactions will be relatively low value, such as in Quirusillas or Comarapa (11, 18, 19)⁷.

6) Large-scale watershed management projects in Bolivia have traditionally been top down, led by outsiders, and have failed. Successful market-based schemes must likely be developed locally.

An analysis of 23 donor-led IWM projects in Bolivia showed that they have generally failed (24). For example, in the Pilcamayo and Bermejo watersheds, international donors have invested tens of millions of dollars independently of the local communities, and the problems of erosion, desertification and pollution in the watershed have not been resolved (16). Meanwhile, in the Pirai watershed, flooding risk to the city of Santa Cruz has been reduced but there is no land-use change strategy, no watershed management plan and no locally run management institutions. Invariably, one of the fundamental problems with IWM projects is that the criteria for their appraisal have been rather narrow, focusing on financial and economic rates of return, income generation, and infrastructure constructed (15, 16). Criteria for success have rarely addressed environmental service provision or the economic requirements to ensure hydrological service provision or future investments. The top-down designed results of IWM projects have usually been: 1) documentation, 2) infrastructure construction, 3) increases in vegetative cover, 4) production support and 5) institutional strengthening. In general, information produced has been descriptive, explicative and in grand quantity, but it has rarely deepened the socioeconomic analysis, nor addressed long-term sustainability. Only rarely have maintenance needs been analysed, and infrastructure works have therefore often deteriorated rapidly (15, 18, 21). Vegetation restoration sub-projects have usually been geared (albeit, often with erroneous assumptions (Calder 1999; Bruijnzeel 2004)) towards providing a long-term solution – and hence have had little short term impact – and have rarely been undertaken at the scale necessary to make a difference (15). Once project funding dries up, such projects are often abandoned, with no recognition that their design was predicated on long-term maintenance. Meanwhile, institutional strengthening has rarely continued after the donor's project cycle finishes (18). In short, a top-down, externally driven agenda has completely failed to manage Bolivia's watersheds. If watershed management is to be successful in Bolivia, managers must recognise that social processes will ultimately determine the sustainability of an intervention (16, 17, 19), and that

7. Larger-scale projects such as in Pirai or Rio Grande (21, 22) will be more difficult to implement without *de jure* rights as such projects will likely cross jurisdictions making local *de facto* property rights less acceptable.

long-term results should be the focus when developing strategies. The valley of Comarapa is a case in point, where social processes are only just beginning to be addressed. A recently completed dam, funded by KFW (a German government-owned development bank), is rapidly deteriorating, as its reservoir floods with silt, and local organisations have been left with no capacity to resolve the situation. The donor and support funds have long gone, while local stakeholders – cattle ranchers, the municipality, communities, and domestic water users – are only just realising that if they do not act quickly the dam will soon cease to function effectively (18). Given Bolivia's history of failed top-down mega-projects, a more participative, locally developed approach may hold greater promise for developing market-based mechanisms for watershed management (19, 20).

7) Given the lack of trust in institutions, market-based mechanisms for watershed management and improved livelihoods schemes will likely only work when people have trust in each other (this suggests small-scale).

In rural Bolivia there is marked distrust of outsiders, and even of NGOs “from the city” (12, 20). As a country with a very low population density, the state has had little rural presence apart from setting up new protected areas and moving people out of biologically important areas. Government is widely perceived as corrupt. When outsiders have arrived, it has usually been to exploit natural resources (17–20). External development interventions have often failed, with many of the projected resources never reaching target communities (15, 16, 18, 21, 24). Building trust thus appears to be the most critical component in ensuring the sustainability of initiatives. Successful examples of incentive-based watershed management have developed endogenously with little outside involvement in Tiquipaya (14, 24); in other cases, such as Incahuasi, local-developed market mechanisms have been piggybacked onto external interventions (13, 20). Incentive schemes for management will likely only work when they take advantage of local mechanisms for project design, implementation and uptake, and explicitly address trust building. Given the lack of trust in most branches of government, there is a critical role for “honest broker” NGOs in which the locals have trust. Moreover, given the lack of effective contract enforcement in Bolivia, trust must be developed between individuals rather than institutions. This suggests that market mechanisms for watershed management can only succeed where individuals know, or can get to know each other. It seems likely that market-based mechanisms must therefore remain small in Bolivia.⁸

8. In theory, markets are anonymous, so do not require participants to know each other, and certainly do not require the high level of trust being postulated as important here. This trust requirement is a result of the lack of adequate institutional support for markets in Bolivia (e.g. the legal sanctity of contracts). Trust is thus a valuable commodity in Bolivian market-like mechanisms for watershed management, demonstrating that most such mechanisms depart quite fundamentally from idealised textbook markets.

8) Extensive, long-term history of successful, market-like initiatives for watershed management in Bolivia can provide models for action and discussion.

Market-like mechanisms have supported watershed management in Bolivia since pre-colonial times (14, 24). Such systems are governed by long-standing, locally developed rules and regulations (13) and have received little if any outside input. Water rights have developed endogenously, sometimes based on the principle of seniority (14), and the ability to transfer rights is often institutionalised. Most communities in which irrigation is important have irrigators' associations that form a critical part of the local institutional fabric (13, 14, 17, 18) (although this is not so in Los Negros (20)). Given the importance of water to the community, these associations often take on roles much wider than simple water management, and indeed sometimes effectively become the local government, even running local television channels (13). Bolivian grass-roots institutions thus already have extensive experience managing market-based mechanisms for watershed management. External interventions can – and must – therefore build on this existing capacity rather than reinventing institutions and trying to create new mechanisms.

9) There is extremely low capacity for project management or innovative thinking about watershed management, so further development of successful market-based initiatives will require significant outside investment in human and financial resources.

Watershed management “projects” (i.e. those promoted by outsiders to “help” communities) have invariably failed in Bolivia. One of the major reasons for these failures is a lack of trained, local, human resources. This has necessitated that projects be designed and implemented by outsiders, who have often lacked knowledge of the cultural, socioeconomic and biophysical context (15–21). Lack of local involvement has meant that project uptake is rare, and failure has often been inevitable. For example, the joint FAO-SEARPI (Food and Agriculture Organisation – Pirai River Flood Channelling and Control Service) project planted extensive eucalyptus plantations that are now ignored by communities in the Pirai watershed as they play no role in water provision, and communities receive no incentive to manage them (15, 21). National and international consultants hired to manage such projects have simply failed to do so, occupying their time writing never-to-be-seen-again reports. Market mechanisms for watershed management will only work if they are developed with high levels of local involvement. Currently, the greatest bottleneck in the process is the lack of human capacity for designing incentive-based mechanisms for watershed management both inside and outside Bolivia. The most cost-effective donor investments will be in building local capacity to design and manage projects, and in training in adaptive management and critical thinking (15–18, 21).



4. Case study results

The case study sites identified in the site selection process (Annex 1) offered opportunities to analyse the potential for payments for watershed services (PWS) mechanisms in both small and large watersheds. A general lesson from the case studies is that in small watersheds, several conditions are necessary before even beginning incentive-based watershed management initiatives. A good diagnostic and local knowledge is critical (26); local government must be convinced of the project's value (12) and the project must be locally "owned", signifying that education and consultation is invaluable. For small, localised projects, high-level political buy-in is not so important, as such projects can "fly under the radar" and not be concerned with national, cultural or institutional issues (13). Though this is a strength of small projects, it is also their fundamental weakness: they are unlikely to influence government policies.

In larger watersheds, there is far greater potential for success at leveraging laws, but also greater likelihood of political difficulties (1). Large-scale interventions thus require far more work at the national scale. Institutions, cultures, laws, education and ways of thinking must be changed before market mechanisms for watershed management could begin to systematically improve Bolivian livelihoods (26). However, this is how such initiatives can have a fundamental impact on policy: impacting people and institutions to leverage change at a national level. The project undertook detailed diagnostics of five watersheds: three (18, 19, 20) small-scale (less than 50,000 hectares), and two (21, 22) large-scale (more than 200,000 hectares).

4.1 Los Negros

In an existing market-based management scheme in the Los Negros valley, 34 farmers are being paid to protect about 2000 hectares of native vegetation. Annual contracts prohibit tree cutting, hunting and forest clearing on enrolled lands. Facilitated by Fundación Natura Bolivia, international conservation donors co-finance *quid pro quo* annual in-kind compensations of one artificial beehive, supplemented by apicultural training, in return for the protection of 10 hectares of forest. The PWS mode was thus initially a "contingent project implementation" approach, rather than the more common contingent cash transfers. Farmer-landowners as service providers submit to independent yearly monitoring, and are sanctioned for non-compliance.



Bee boxes: in kind payments for watershed services

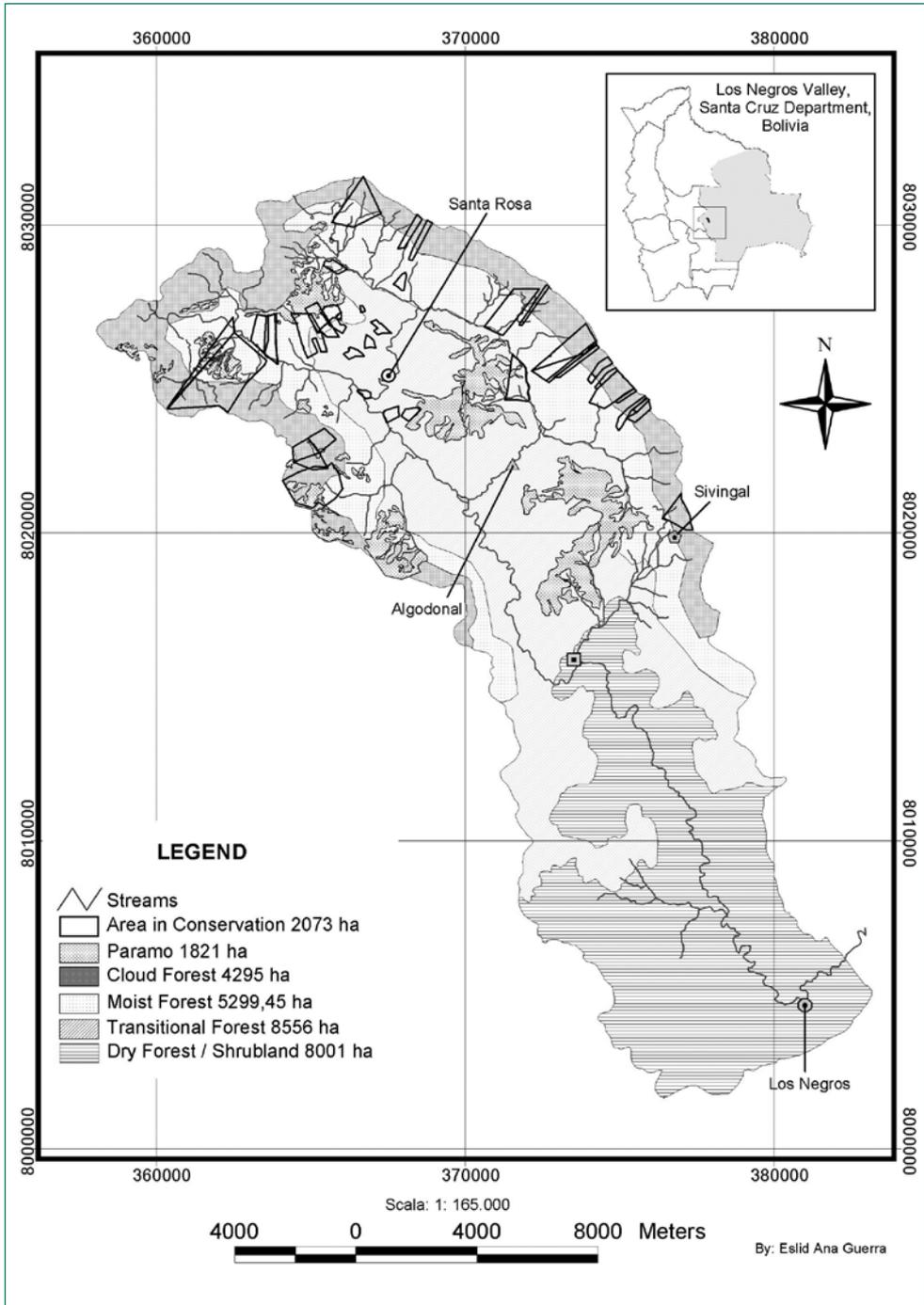
The second service users are downstream irrigators who likely benefit from stabilised dry-season water flows if upstream cloud forests are successfully protected. Individual irrigators have been reluctant to pay, but the Los Negros municipal government has on their behalf recently contributed about US\$3500 to the scheme. Locally organised environment committees and education programmes have increased awareness in downstream communities of the likely water-supply reduction effect of continued upstream land-use change. External donors have funded initial studies providing basic economic, hydrological and biodiversity data, and covered PWS start-up and running transaction costs (about US\$23,000 per year over the past 3 years). The greatest challenge for the initiative has been the slow process of building trust between service buyers and providers. Another is to achieve clear service-provision additionality; PWS implementation has gone from flat per-hectare rates to spatially differentiated compensation levels in order to target land uses that are particularly important for watershed protection.

The diagnostic (20) showed that the scheme has great potential to be expanded, and Fundación Natura Bolivia has since accessed additional donor funds (United Nations Development Programme and Fundación PUMA) to continue the initiative. However, such projects require intensive one-on-one interactions with farmers to ensure their success, and so have extremely high transaction costs in their initial phases. In Los Negros, these high up-front costs have been underwritten by donors and external actors, which somewhat limits the scope for replication. IIED support allowed project implementers to undertake hydrological modelling that clearly demonstrated to downstream water users the potential affects of continued upstream land use change (7). Within a month of being presented with the model's results, Los Negros irrigators had formed an association to respond to the upstream deforestation problem.

4.2 Comarapa and Quirusillas

The Comarapa and Quirusillas watersheds were identified as among the top three watersheds in Bolivia that are most apt for the development of PWS systems. Each of the upper watersheds is covered by cloud forest that is threatened by changing land-use patterns (notably extensive cattle ranching). Downstream users are highly dependent on dry-season water flows to support large areas of irrigated agriculture, but are relatively well off, with Comarapa already counting on a KfW-funded dam, and Quirusillas about to begin construction in 2006. If current changes in upper watershed land use continue – i.e. there is continued deforestation – both dams run the risk of siltation reducing their useful lifespan.

The Centre for Tropical Agricultural Research (CIAT) has assessed the willingness to pay for watershed services in Comarapa, and concluded that downstream farmers would be willing to contribute more than US\$20,000 a year to ensure the dam continues to supply irrigation water. In Quirusillas the Eastern Training Institute (ICO) has already developed a series of small-scale PWS systems. Although very successful, these schemes were by definition small-scale and have helped farmers within micro-watersheds manage their own water resources. There is a need for scale up to help protect municipal water supplies. Based on the results of the diagnostic assessments (18, 19) and a series of meetings with mayors, watershed residents, local NGOs and community leaders, Fundación Natura Bolivia has been asked to develop incentive-based watershed management projects in both watersheds. Initial funds have been received from the Blue Moon Fund and the US Fish and Wildlife Service.



The Los Negros watershed and areas conserved in the compensation system

4.3 Pirai

The Pirai watershed, a sub-watershed of the Rio Grande, has more than 2 million downstream residents. Most live in the city of Santa Cruz and are dependent on the river for their drinking water. SAGUAPAC, the city's largest water cooperative, estimates that at current rates of use, the city will have no water by 2020. The cooperative is therefore actively searching for new sources and improvements in the management of existing supplies. SEARPI has been managing the river for flood control since the 1960s (15, 21), but little investment has been made in managing for increased dry-season flows or aquifer recharge. About half of the Pirai's discharge comes from the forests of Amboró National Park, with another 25% emerging from the unprotected flanks of the park in the municipalities of Porongo and El Torno (15). As a result of the diagnostic study (21) and a presentation of its conclusions⁹, officials from SAGUAPAC and the municipality of Santa Cruz requested a technical proposal on how incentive-based management could help protect and improve water supplies. The new insight that the IIED-funded study brought to the discussion was to view watershed management through the lens of land use and land-use change. This focus highlighted that a small proportion of the watershed was providing a disproportionate amount of the water. Protection of a relatively small area of Andean foothills thus suddenly became a logical management goal for the city of Santa Cruz.

4.4 Rio Grande

Recent catastrophic flooding of the Rio Grande has decimated downstream agricultural production, causing US\$250 million in damages since 1992 and in 2005 destroying 54,000 hectares of cropland (22). The departmental government of Santa Cruz has begun developing an action plan for the upper watershed, declaring its intention to create the Río Grande-Masicurí protected area (Prefectural Resolution 075/01). Even though the importance of upstream forests in (at least) mitigating the incidence and magnitude of floods is commonly acknowledged, neither national nor departmental governments have resources available for even the most basic studies for creation of a watershed protection reserve. More importantly in the long term, there are no government funds for protected-area management, even if a reserve were created.

Many upstream municipalities are interested in forest management, and one, Cabezas, recently created the 39,000 hectare Parabono Municipal Protected Area. However, current patterns of land-use change suggest that few upper watershed forests will be effectively protected unless local farmers receive compensation for the opportunity cost of not converting forest to pasture. Given the high incomes

9. Juan Carlos Sauma, IIED-supported workshop in Santa Cruz, 19 September 2006.

of downstream rice and soy producers, and their reliance on flood minimisation to maintain their incomes, it seems likely that downstream farmers could be convinced to contribute to upstream watershed management. Preliminary results from the diagnostic (22) persuaded the Santa Cruz Departmental Government to allocate funds in the 2007 operating budget for developing a PWS management plan for the watershed. The diagnostic also provided scientific justification for the creation of a new Departmental Rio Grande Conservation Area, that will likely include protection of 350,000 hectares of hydrologically important watersheds.



The cloud forests bordering Amboró National Park provide water to the valleys of Comarapa, Los Negros, Pirai and the Rio Grande

5. Conclusion

Bolivia's water resources are in urgent need of improved management. In the mountains and high plains, such improvements must come from improved husbandry of intermittent flows that come from glacier or snow fed rivers. Water is scarce in the altiplano, land-use practices have little impact on flows, and the idea of using incentives or market mechanisms for management is culturally alien and politically unlikely. Much of the final meeting of the IIED-supported project in La Paz was spent discussing the philosophical rationale for incentive-based management, with many participants, including some government officials, rejecting the concept outright.



Dr. Erwin Aguilera describes the new environmental services policy for Santa Cruz

The only similarity in Santa Cruz is the severity of the water crisis. At the Santa Cruz final meeting representatives of four municipalities, city government, Departmental government and the city water cooperative wanted to know what, given the information presented, they should do in response. Rather than discuss philosophies, lowland Bolivia wants to act. The IIED-coordinated investigation on "Developing Markets for Watershed Protection Services and Improved Livelihoods" has come at a critical policy moment for the Departments of Tarija and Santa Cruz. Decision-makers in lowland Bolivia are currently deciding how to manage their water supplies for the projected growth rates in the early 21st century. Thanks to this DFID-funded research, market mechanisms are part of the portfolio of tools that will be used. For example, on 28 January 2007, a year after accompanying IIED to Costa Rica to learn about that country's use of payments for environmental services, Dr Erwin Aguilera, Santa Cruz Department's Secretary for the Environment, announced a new environmental services policy for the Department's 37,036,830 hectares. The policy – in part drafted by Fundación Natura Bolivia – is based firmly on the principle that users of environmental services need to contribute economically towards their maintenance, and will likely prove to be an important step as Bolivia tries to negotiate fairer deals for watershed services.

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Annex 1: Site selection process for incentive-based watershed management

Not all watersheds are appropriate for the development of PWS schemes. The capitalising of an environmental service can only occur if there is a service, a potential buyer and a potential seller. To prioritise where in Bolivia there is the greatest potential that market-based watershed management schemes could work, we designed a national-level multi-step site-selection process. The objective was to develop a systematic, transparent, science-based process that could effectively identify the Bolivian watersheds that had the most potential for development of payment systems (4, 5).

The first level of the analysis used nationally uniform, publicly available maps and statistics to make a first approximation of appropriate sites (4). Maps were overlaid in a GIS system that identified watersheds that fulfilled the following criteria¹⁰:

Biophysical criteria

- Presence of threatened but currently well-conserved humid (preferably cloud-) forest in the upper watershed (following literature reviews suggesting that only cloud forest can definitively be counted on as helping provide dry season water flows (e.g. Calder 1999; Bruinjeel 2004)).
- Maximum altitude of 4000 metres (to exclude watersheds that depend on glaciers and snowmelt rather than forest cover).
- Watershed size 200–2000 km² (to ensure a visible upstream–downstream relationship).
- Altitudinal gradient of at least 500 metres and an average 5% slope (to enhance the probability that there is an obvious upstream–downstream relationship).

Socioeconomic criteria

- Downstream communities of at least 2000 people (“buyers”).
- Population distribution that allows differentiation of upstream and downstream communities, which are relatively close, preferably with a large population downstream.
- Upstream population (“seller”) currently has influence over upstream land use decision-making.

These selection criteria allowed the identification of 37 sub-watersheds. Many watersheds were excluded because their upper sections were not forested or were of an inappropriate size. Thus, the quite liberal biophysical and socioeconomic selection criteria suggest that there are only 37 watersheds in the entire country of

10. These criteria were discussed and improved upon by the project’s Group of Experts and so represent a consensus opinion of the most important criteria.

Bolivia where PWS schemes could even begin to be biophysically and economically feasible. This point highlights the finding that implementation of payments for watershed services is likely to be only of very limited scope globally (4).

Once the first stage of the analysis and mapping was complete, and the 37 watersheds had been pre-selected using nationally available data, other criteria were applied on a case-by-case basis to refine the selection using previously collected local data and expert knowledge. The second level of analysis checked for the presence of:

- Important downstream irrigation or agricultural water demand.
- Dry-season water scarcity.
- Water use patterns that generate economic benefits.
- Presence of conflicts of interest between upstream and downstream users.
- High level of community organisation with the presence of economic, social or other community-based organisations.
- Local interest in improving living standards.
- Open local attitudes to improving watershed management.
- History of valuing environmental services initiatives.
- Threatened upstream ecosystems.

Desk-based analysis of locally collected data allowed refinement and sometimes replacement of the national-level data points. Some watersheds were therefore excluded in the second analysis because the more detailed data showed that populations were actually too few, or too diffuse, or not easily definable as upstream and downstream. Other watersheds were excluded because of their high levels of social conflict. The remaining watersheds were then prioritised and ten selected, based on their downstream population size and water demand (5, 7). Of these ten, the four most promising (and later one more) were selected for further study (18-21).

Annex 2: Consultants' reports

(Numbers referred to in text all are available at www.naturabolivia.org).

1. Policies, institutions and laws at the national level: who's who in Bolivia water management (Alfredo Durán and Rocio Bustamente).
2. The decentralization law (of Popular Participation) and local incentives for watershed management (Carlos Hugo Molina).
3. Municipalities, prefectures, and local incentives for natural resource management (Maria Teresa Vargas).
4. Hydrological resources and the forest/water relationship in Bolivia (Robert Muller).
5. A diagnostic analysis of the potential of 10 Bolivian watersheds for PES systems (Robert Muller).
6. Hydrological evaluation of the Comarapa and Pirai watersheds (Jorge Seifert Granzin).

7. Hydrological evaluation of the Los Negros and Quirusillas watersheds (Mauricio Auza).
8. Government policies on poverty reduction and the potential for market based mechanisms for watershed management (Edil Osinaga).
9. Updated analysis of market initiatives for watershed management (Nigel Asquith).
10. Drivers of land use change in the Santa Cruz valleys (Marco Antonio del Rio).
11. The role of property rights in restricting/promoting market mechanisms for watershed management (Diego Pacheco).
12. Stakeholder analysis in two watersheds: are market mechanisms an acceptable form of watershed management in Bolivia's valleys? (Cindy Michel).
13. Communal watershed management schemes in Inchausi: what are the lessons for promoting market based incentives? (Carmen Crespo).
14. Communal watershed management schemes in Tiquipaya: what are the lessons for promoting market based incentives? (Paulina Pinto and Alfredo Durán).
15. Integrated water management in Bolivia: lessons for the development of market based incentives from the Rio Pirai (Juan Carlos Sauma).
16. Integrated water management in Bolivia: lessons for the development of market based incentives from the San Jacinto basin (Ekaterina Pivinskaya).
17. The socioeconomics of promoting market mechanisms for management in Quirusillas (Karen Garcia).
18. Case study 1: the potential for market-based mechanisms for watershed management and improved livelihoods in the valley of Comarapa (Edil Osinaga).
19. Case study 2: the potential for market-based mechanisms for watershed management and improved livelihoods in the valley of Quirusillas (Edil Osinaga).
20. Case study 3: the potential for market-based mechanisms for watershed management and improved livelihoods in Los Negros (Esteban Cardona).
21. Case study 4: the potential for market-based mechanisms for watershed management and improved livelihoods in the Pirai river (William Cabrera).
22. Case study 5: the potential for market-based mechanisms for watershed management and improved livelihoods in the Rio Grande (Israel Vargas and Edil Osinaga).

Key selected pre-diagnostic reports

23. Cultural aspects and vision of water use and management (Carmen Miranda).
24. Watershed Management in Bolivia, and analysis of water management in Andean watersheds (Alfredo Durán).
25. Bolivia's Water Resources: Supply, Quality and Use (Jorge Molina).
26. The Association for Water Protection in Tarija and the Communities of the Tolomosa and Vitoria Watersheds (Alfonso Blanco and Ricardo Aguilar).
27. Innovative incentives for water management (Alfredo Durán).

Natural Resource Issues

If poverty is to be reduced and livelihoods improved, significant shifts in policies, institutions and markets will be required to encourage sustainable natural resource management. How to go about this is a major challenge facing governments and civil society groups. Much guidance is available for farming, forestry and fisheries, but in reality livelihoods depend upon many forms of natural capital and are not amenable to sectoral interventions. This series of reports aims to present material on key crosscutting themes of significance to many natural resource sectors, including water, soil, biodiversity, carbon and climate.

Other reports in the Natural Resource Issues Series are available from IIED on request and can be downloaded from www.iied.org:

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2. Laying the foundations for clean development: preparing the land use sector. A quick guide to the clean development mechanism. 2002. Auckland *et al.*
3. Integrating global and local values: a review of biodiversity assessment. 2002. Vermeulen and Koziell.
4. Local action, global aspirations: The role of community conservation in achieving international goals for environment and development. 2006. Roe *et al.*
5. Towards better practice in smallholder palm oil production. 2006. Vermeulen and Goad.
6. Environment at the heart of Tanzania's development: Lessons from Tanzania's National Strategy for Growth and Reduction of Poverty (MKUKUTA). 2007. Assey *et al.*

Fair deals for watershed services in Bolivia

Although Bolivia is one of the countries with the most water per capita in the world, and demand is about 1% of supply, localised water scarcity continues to breed conflicts. Despite many attempts at integrated watershed management, there have been few successes. Interventions have usually been through top-down laws and regulations, few of which have succeeded.

In this report, Fundación Natura Bolivia examines whether payment schemes can improve watershed management and the livelihoods of watershed residents. It describes the reports commissioned as part of the analysis, what they were intended to assess, and their findings. The report concludes by offering lessons learned for negotiating fair deals for watershed services in Bolivia.

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