

Watershed management and poverty alleviation in the Colombian Andes

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Abstract

Watersheds, especially in the developing world, are increasingly being managed for both environmental conservation and poverty alleviation. How complementary are these objectives? In the context of a watershed, the actual and potential linkages between land and water management and poverty are complex and likely to be very site specific and scale dependent. This study analyzes the importance of watershed resources in the livelihoods of the poor in two Andean watersheds. Results of the participatory poverty analysis reveal significant decreases in poverty in both watersheds over the past 25 years, achieved largely by diversification of livelihoods outside of agriculture. Water is an important resource for household's welfare; however opportunities for reducing poverty by increasing the quantity or quality of water available to the poor may be limited. While improved watershed management may have limited direct benefit in terms of poverty alleviation, there are also important indirect linkages between watershed management and poverty, mainly through labor and service markets. The results also suggest that the interests of rich and poor are not necessarily in conflict. Sectoral rather than socio-economic differences may define stakeholder groups. The findings have implications for policymakers, planners and practitioners in various sectors

Introduction

Watersheds, especially in the developing world, are increasingly being managed for poverty alleviation as well as environmental conservation objectives (Tennyson and Zingari, 2003; FAO2006). This is a positive development since past investments in watershed management often overlooked the social and economic impacts of the technologies they promoted (Pretty and Shah; 1999). In some cases, the poor even bore the costs associated with watershed management while the rich reaped the benefits (Kerr, 2002).

The actual and potential linkages between land and water management and poverty are, however, complex and likely to be site specific and scale dependent (Swallow *et al.* 2006). Empirical evidence on the relationship between watershed management and poverty is relatively limited. Many reviews have documented adverse impacts of past

watershed management on small farmers and the poor. However the fact that poorly-designed projects harmed the poor does not necessarily imply that well-targeted programs will lift them out of poverty, especially where alleviating poverty is understood to mean moving households across a threshold from poverty to prosperity rather than simply having a marginally positive impact on their livelihoods (Carter and Barrett, 2006). This is an important distinction since funds for both development and conservation are scarce in most developing countries and need to be targeted to where they will have the biggest impact.

This paper examines the relationships between poverty and watershed management in two watersheds in the Colombian Andes. Poverty is defined and measured using a participatory methodology that looks at changes in poverty levels over time as well as the reasons behind the changes at the household scale (Krishna, 2006, 2004; Krishna *et al.* 2006; Krishna *et al.* 2004a and b). These reasons are then examined in the context of the economic and environmental dynamics of the watersheds to identify where and how watershed management interacts with livelihood strategies of the poor. The implications for policy makers and planners are discussed.

Watersheds managements, livelihoods and poverty

Until the 1990s, watershed management was viewed as an engineering problem, and technical solutions for controlling erosion, reducing runoff and flooding, and enhancing groundwater recharge were often designed and implemented with little regard for their impacts on people's livelihoods, on farm profitability, or on social equity (Pretty and Shah, 1999; Johnson and Knox, 2001). As a result, many programs were unsuccessful, and technologies and practices were often abandoned by farmers as soon as they stopped being forced or paid to adopt them. Reviews of watershed experiences in the 1970s and 1980s identified the lack of attention to farmer objectives and farmer knowledge as important reasons for these failures. In contrast, where user participation was incorporated, performance of the watershed projects improved (Kerr, 2002).

As a result of these lessons, many participatory watershed development interventions were designed and implemented with explicit involvement users and sought to address their livelihood concerns as well as environmental conservation issues. While few rigorous evaluations of this experience exist, case studies suggest that their performance has been better, at least in terms of governance and technology adoption (Hinchcliffe *et al.*, 1999; Perez and Tschinkel 2003; Grewel *et al.* 1999).

Post 2000, watershed management programs sought more explicitly to embed the local participatory planning processes initiated as part of the participatory watershed initiatives within broader social and political processes (FAO, 2006). The focus shifted from working directly with local groups on land and water issues to supporting multi-stakeholder negotiation platforms which addressed a range of issues including but not limited to natural resource management. Compared to past efforts, more emphasis is placed on conflict resolution and on linking social, institutional and hydrological scales. Where early project promoted participation of stakeholders—and often focused specifically on disadvantaged stakeholder groups—more recent projects seek to foster

collaboration between different types of stakeholders and stakeholder groups (FAO, 2006)

The incorporation of non-NRM issues may be beneficial to the poor where their ability to benefit directly from better land and water management is limited. However, multistakeholder processes raise issues of power, and questions about how the poorest and most marginalized can participate effectively. Many watersheds are very heterogeneous, with high levels of political and economic inequality. The danger of elite capture can be high since there is often a void at the intermediate scale—e.g., regional and provincial--between communities and higher level government institutions where these issues should be addressed and where the poor might fare better (FAO, 2006).

Anticipating the linkages between watershed management and poverty in this context is likely to be very difficult. The livelihood strategies of the poor interact with land, water, forests, pastures and other resources in a range of ways. Even though they may not “own” them, the poor, even the landless poor, are often able to access and use resources. In particular, the common areas of watershed such as forests, fisheries, pastures, swamps, roadsides can be exploited for fodder, building material, food, game meat, fish, medicine and other useful products. A cross section of studies in different settings shows that the commons often make a positive contribution to the livelihoods of the poorer and marginalized members of communities (Beck and Nesmith 2001; Jodha 1986, 1995; Dei 1992) and can even reduce inequality (Reddy and Chakravarty (1999; Cavendish 2001; Fisher, 2004). Therefore decisions about how these common lands and other resources are used will have major effects of the poor.

While natural resources continue to be important livelihood assets, the livelihood strategies of rural households are increasingly diverse. Even in rural areas, households do not depend exclusively on agriculture or extraction of natural resources. Off-farm income from sale of labor or commercialization of products and services is important for household welfare of the rural poor (Barrett and Reardon 2000; Bryceson and Jamal 1997, Reardon 1997, Little *et al.* 2001 cited in Barrett *et al.* 2001). While motivation for diversifying livelihoods strategies may be either positive (pull factors) or negative (push factors), a growing number of studies suggest that such strategies do have unambiguously beneficial effects on rural livelihoods (Shivakoti and Thapa 2005; Block and Webb, 2001; Lanjouw *et al.* 2001; Barrett *et al.*, 2001a). Therefore, the impacts of environmental, industrial, transportation and other policies that often are come under the ambit of modern watershed management may have significant implications for the poor’s welfare.

In considering the livelihoods strategies and their contributions to rural welfare it is evident that off-farm incomes are critical, and that the magnitude of benefits varies depending on prior distribution of assets such as education and/or social networks and on structural factors such as market access and also on gender; all of which can be critical entry barriers (Krishna, et al 2004). Therefore these assets, as well as ownership of or access to land and water, become important determinants of the size and distribution of impacts of watershed management programs. The focus on the assets underlying the ability of households to escape from poverty has been an important contribution of recent analysis on poverty traps and persistent poverty (Carter and Barrett, 2006; Barrett and Swallow, 2006).

Description of the study sites

The Lake Fuquene and Coello River watersheds are typical of the socio-environmental situation in the Andes (Ramírez and Cisneros 2006).

Lake Fuquene Watershed¹

Fuquene Lake watershed (Fuquene) encompasses the valleys of Ubaté and Chiquinquirá in the states of Cundinamarca and Boyaca, Colombia (Figure 1). Fuquene is located about two hours from the Colombian capital, Bogotá, on a good all-weather road. It covers an area of 187,200 ha, including 17 municipalities², with a population of 229,000 (Rubiano 2005), about 59% of which is rural (DANE 2005). The altitude ranges from 2300-3300 masl, with an annual rainfall between 700 and 1500 mm. For the municipalities in the watershed, the 2003 Life Condition Index, a measure of welfare, ranged between “very low” and “high” (Sarmiento et al, 2006), reflecting the socioeconomic heterogeneity in the zone.

The largest land use in the watershed is pasture (59%), followed by agriculture (26%), forest (4%), páramo (2%) and lake (2%) (Rubiano *et al.* 2006). Land degradation is a serious concern, with 13,000 hectares classified as severely eroded and 40,000 as moderately eroded. In the past, major investments were made in soil conservation activities, however aside from stabilizing fragile areas, the impact of these investments on productivity has not yet been rigorously assessed. Conservation tillage was widely promoted, however adoption was limited until recently when it began to be promoted under a payment for environmental services (PES)-type scheme began to promote it (<http://www.condesan.org/Andean/projects.htm>).

The principal economic activities in the watershed are agriculture (cropping and dairy) and mining. The medium and large scale dairy operations, located in the lower part of the watershed along the shores of the lake, are high input and highly productive. Land values in this area are among the highest in the country, and many hacienda owners are wealthy and politically well connected.

Crops are grown mainly in the upper and middle parts of the watershed. Land ownership in upper and middle part of the watershed is generally by smallholders, however in the higher areas appropriate for potato cultivation, much of the land is rented out to large-scale producers who better able to take this risks associated with this high risk-high reward crop. Despite the fact that it is against environmental regulations, significant cultivation occurs in the páramos, which are ecologically fragile and play a key role in maintenance of ecosystem function, especially supply and regulation of water flow (Rangel, 2006).

Lake Fuquene, a RAMSAR site located at the bottom of the watershed, is at the center of environmental controversy. The health of the lake, mainly for biodiversity but increasingly as a provider of environmental services such as tourism and urban water

¹ For more information see <http://www.infoandina.info/andean/index.shtml?apc=Ba1e1-&s=B&e=h>

² The municipalities that belong to the Fuquene watershed are Carmen de Carupa, Ubaté, Tusa, Sutatausa, Cucunubá, Suesca, Villapinzón, Lenguazaque, Gachetá, Fúquene, Susa y Simijaca in Cundinamarca and San Miguel de Sema, Ráquira, Caldas, Chiquinquirá y Saboya in Boyacá.

supplies and flood control, is currently driving change in the watershed³. The national government and the regional environmental authority have placed high priority on resolving the problems of Fuquene, prompted in part by massive floods in 2006 that focused nation-wide attention on the issue (DNP, 2007).

The environmental authority for the Fuquene watershed, the Corporacion Autonoma Regional de Cundinamarca (CAR)⁴ is responsible for developing and implementing the watershed management plan, and there is widespread discontent with their inaction. Local municipal governments have some responsibility for resolving water conflicts and for undertaking conservation activities. While some are more active than others, they are limited in what they can achieve given their purely local scope. There are few NGOs or civil society organizations working in Fuquene. Fundacion Humedales has been doing research and conservation around the lake, and is interested in moving its efforts upstream, given that many of the lake's problems originate there. Local universities and international organizations have a research presence, but little had been done in terms of mobilizing communities to address watershed level issues politically.

Within communities there are examples of how members come together to manage water resources collectively, and there have even been cases of collective action to defend legal right to water from springs when landowners have attempted to limit access. However attempts to manage upstream-down issues in the watershed via local collective action have not been successful. Despite the relatively good accessibility within the watershed, communication between people in different areas is limited, which makes it difficult to achieve a collective vision of the watershed and understanding of the challenges facing it (Cardenas et al, 2007).

Coello River Watershed

The Coello River watershed, located the state of Tolima in the central Andean Cordillera (Figure 2) covers an area of 190,000 ha, ranging from 280 to 5300 masl. Annual rainfall ranges from below 1000 mm to more than 3970mm. The watershed includes ecosystems ranging from dry forest to páramo to snow-capped peaks, and is home to national parks and private reserves. The watershed contains some or all of 8 municipalities⁵ with a population of 622,395 in 2005, including the city of Ibagué (pop. 425,770). Including the city of Ibague, only 16% of the population is rural and even without Ibague urbanization rates are above 50%. The life condition index for municipalities in the Coello watershed range from “medium low” to “medium high,” a slightly narrower range than for Fuquene, with urban municipality scoring higher than rural ones (Sarmiento *et al*, 2005). The Pan-American Highway passes through the watershed, generating economic activity but at a cost of soil erosion and air pollution.

Principal economic activities in Coello include agriculture and livestock. The upper part of the watershed is mainly forested, however land there is increasingly being converted for livestock, coffee and horticultural crops. In the middle altitude areas, sugar cane and

³ See <http://www.livinglakes.org/fuquene/>.

⁴ See <http://www.car.gov.co>

⁵ The municipalities that make up the Coello River watershed are Ibagué, San Luis, Rovira, Cajamarca – Anaimé, Espinal, Flandes, Valle del San Juan y Coello.

fruit trees are common; this regional accounts for 30% of Colombia's fruit and vegetable production (Fujisaka, 2007). The lower part of the watershed includes 30,000 ha of large-scale, irrigated rice, cotton, and sorghum as well as beef cattle. Rice demands the largest share of water channeled through the rivers and irrigation systems (500 million m³) followed by fruit (41 million m³) and coffee (1.5 million m³) (ibid).

Colombia's internal conflict between the government and guerillas impacts Coello much more than Fuquene. Fuquene is very safe, however in Coello guerrilla groups are present in the upper parts of the watershed, and as a result many families have had to flee the zone.

Water has not traditionally been scarce in Coello, however there is growing awareness that inappropriate land use in the upper watershed combined with growing demand for irrigation, domestic water and hydroelectric power in the lower areas are rapidly leading to a situation that is not sustainable. Water quality is also an issue as contamination is increasing due to agrochemical use, and domestic and industrial waste. High sediment loads--from soil erosion throughout the watershed—are not only threatening the irrigation scheme, but also possibly reaching the Rio Magdalena, Colombia's major and navigable river. This has been identified as a national problem, and one that may now be affecting ports in Central America (Fujisaka, 2007).

As in Fuquene, the driver for change is the environment, however in Coello the process is "top down" in the sense that it focuses on conserving the upper part of the watershed. Wildlife Fund (WWF), Semillas de Agua and other NGOs are working to preserve the *paramos* and in doing so are seeking to link with downstream stakeholders who are or could benefit from the environmental services the *paramos* provide.

The environmental authority responsible for the Coello watershed is the Corporacion Autonoma de Tolima (CorTolima (<http://www.cortolima.gov.co>)). Progress on a comprehensive plan has been slow. There is a wider range of actors with a continuing presence in Coello than in Fuquene. Nonetheless, there is no articulation in terms of addressing watershed problems, and the same lack on collective vision and understanding of problems that is present in Fuquene is also evident in Coello.

The dynamics of poverty in Fuquene and Coello

Methods

To identify the poor and understand the role of water in their livelihoods, we used the Stages of Progress (SOP) methodology (<http://www.pubpol.duke.edu/krishna/methods.htm>). SOP was developed to assess both the dynamics of poverty and the causes behind them. While national-level poverty rates are often slow to change, poverty is not a static situation. It changes as a result of seasonality, climate variability, household-level shocks (such as illness and death), lifecycle changes, and public policies. In addition, the group of poor people is itself constantly changing as individuals and households either escape from poverty or descend

into it. Looking at the same households over time provides a better understanding of the conditions that keep people in poverty and those that move them out in order to identify general patterns and to assist policy targeting (eg Sen 2003, Barrett, Carter and Little 2006). It provides us with better insights into the processes that lead to patterns of disadvantage and inequality, and just as important identifies different ways by which the poor may improve their welfare. In both cases, public policy can be tailored to maximize protection and support for the most vulnerable without pulling back those who are escaping.

SOP is a participatory methodology that relies on community definition of poverty at a household scale. The poverty level of each household in the community is assessed, and explanations sought for changes in poverty status over time. The method takes its name from the stages or steps that a household passes through as it makes its way from poverty to prosperity. To define the stages, a representative group of community members must first come to agreement on a definition of poverty, based on a shared conception of “poorest family in the community.” Once this is done, the group successively answers the question “What would this family do with additional resources?” until they reach the point at which the household would be considered prosperous. Because they are defined locally and in reference to a particular poor family, the stages vary by community and reflect the specific conditions and values of the community.

Once the stages are identified, the group then assigns each family in the community—based on a census which must be obtained or constructed—to the stage where they currently are and the stage where they were at some point in the past, usually 10, 20 or 25 years ago. Families are then categorized as follows:

A	–	Poor	in	the	past,	poor	now	
B	–	Poor	in	the	past,	not	poor	now
C	–	Not	poor	in	the	past,	poor	now
D	–	Not	poor	in	the	past,	not	poor now

For a randomly-selected sub-sample of families, the community then identifies the reasons behind changes in poverty status. The final step in the methodology is to conduct follow-up interviews with a sample of families to confirm the results of the community analysis and to gather more information on specific issues. In the case of this study, interviews included questions on water use, conflicts, and management at the household and community scale.

Results

In 2005, the SOP methodology was applied in 14 communities (veredas) in six municipalities in the Fuquene watershed, and 12 communities in five municipalities in the Coello watershed (Table 1). A total of 1061 households were classified. Sites were purposively selected in the upper, middle, and lower parts of the watershed, on the basis of prevalence of poverty and the expected intensity of water conflicts. Site selection was based on available secondary data and on interviews with key informants. Information gathered in each community consisted of quantitative data from the SOP methodology—including movement in and out of poverty and their main causes—as well as qualitative

data from interviews with households and key informants, and from observations by project staff in the field.

Definition of poverty and stages of progress

The poorest families in the communities were identified as landless day laborers who lacked quality housing, health care and other services, and who were unable to send their children to school. Non-material dimensions of poverty were also mentioned, even though they could not be incorporated explicitly into the stages of progress. In both watersheds, non-participation in community activities was considered to be an indicator of poverty. Half of the communities in Coello included this in their definition of the poorest family. In Fuquene, participation in community activities was considered to be a component of well being. The fact that communities mixed material and non material aspects in an exercise based around material ranking suggests that the two sets of indicators are highly correlated and identify the same people as poor. These findings, especially regarding participation, have significant implications for the potential equity impacts of participatory, multi-stakeholder negotiation processes

The number of stages that communities defined ranged from 7 to 24, and the number of stages below the poverty line ranged from 3 to 10. As expected, acquiring basic necessities such as food, education, clothing and housing were the most common early stages in nearly all communities (Table 2). This is consistent with findings from other applications of SOP (Krishna et al 2004; Krishna et al, 2006). As household welfare increased, the items mentioned in the stages began to diverge with some communities focusing more on agriculture-related investments, others on services—electricity and running water—and others on durable goods (Peralta et al, 2007).

Twenty three of 26 communities mentioned access to water as a stage, either by itself or as part of “services” (electricity and running water). In only one community (Chinzaque in Fuquene) was agricultural use of water specifically mentioned. While acquiring water usually means getting a household connection to a potable water system, domestic water is used for productive, income-generating activities as well. In Fuquene, for example, small-scale cheese processors must have access to piped water in order to get certification to sell their products.

In nine communities (31%), water appeared in categories below the poverty line. In the remaining communities it was either not mentioned or was a stage above the poverty line. One reason that water is above the poverty line is that in many cases households have good access to water from natural sources such as wells or springs or from shared taps. Thus, a home connection is somewhat of a luxury. Where water above the poverty line, improving access would improve livelihoods but would not reduce poverty *per se*. In three communities (12%), water was included in the stage just below the poverty line, which means that improving access could literally get households out of poverty. Ranked from most to least demanding, the three communities where water is the last stage before getting out of poverty occupied 5th, 15th and 20th places. There seems to be no pattern between importance of water and other elements of overall wellbeing of the community.

What this means in terms of how many poor households could actually be helped by better access to water in these communities depends on how many still do not have it. According to the data, 13% of households are without water in communities where access to water is included in categories below the poverty line. Of these 4% are at the limit where getting access to water would get them out of poverty. Keeping in mind that these data come from communities purposively selected because of poverty and water problems, the results would likely overstate the potential impact for the watershed as a whole.

These results suggest that opportunities for reducing poverty through increased provision of water in these study communities are relatively limited. There are specific cases of households and communities that would benefit significantly from improved access to water, however in general this is not the case. As Table 2 suggests, interventions to improve access to food, education, clothing, housing, small animals or land would be better targeted towards helping the poor. This conclusion is consistent with the results of another study of poverty and water in Bolivia that used a different participatory methodology but found similar results (Westermann), as well as the results of an SOP analysis of 40 communities in 2 regions of the Peruvian Andes in which water access was not mentioned among the stages of progress (Krishna et al, 2006).

Poverty dynamics and causes of change

According to the results of the categorization of families (Table 3) poverty declined in nearly all communities over the last 25 years. In 1980, roughly 70% of families in both watersheds lived in poverty. Between 1980 and 2005, 30% of the families in Fuquene escaped poverty (Category B), while only 3 percent fell into poverty. In Coello, the results are even more dramatic; 59% of families got out of poverty while only 3 percent became poor. These results clearly show that people in rural communities perceived important advances in their quality of life in recent decades. Nonetheless, over 40% of families in Fuquene and 10% of families in Coello continued to be poor in 2005.

For each family in the sample, up to three causes were identified to explain the change in poverty category between 1980 and 2005. A total of 25 different causes were identified (Table 4). Among the causes that were mentioned in first place for each family, the most common was off-farm employment (20%), followed by inheritance (17.2%), help from family and friends (9.4%), day labor (7.8%) and help from the government (7.5%). These results are consistent with the diversification of rural livelihoods away from agriculture.

The results are similar for Fuquene and Coello, with the important exception that small-holder agricultural production was much more important in Coello than in Fuquene, which is consistent with the much better quality of land held by small farmers in the former compared to the latter (Tables 5 and 6). In Coello, agriculture is the most frequently mentioned first cause, followed by off-farm employment and day labor as the second and third causes for changes in poverty status.

Among secondary causes, off-farm employment and help from family and friends continue to be important; however other causes such as agricultural production, and savings and investments also were mentioned. Government assistance and agriculture were the most important third causes.

In general, households with more causes were better off than households with fewer causes (Table 7). This is also consistent with the diversification hypothesis and with findings from other studies.

As expected, in the majority of cases specific causes are associated with either progress or poverty. Regressing cause dummy variables (1=cause was mentioned for the household, 0 if not mentioned) on a dummy for whether the household was poor in 2005, we can see the contribution of each cause to poverty reduction (Tables 8 and 9). According to the results (Tables 8 and 9) the probability of being poor in 2005 was reduced for families with stable jobs (-37%), agricultural production⁶ (-35%), government help (-30%), pensions (-27%), help from family and friends (-23%), livestock (-23%), savings and investment (-22%), or inheritance (-17%). The probability of being poor in 2005 was increased by family problems (+62%), health problems or accidents (+37%), or starting a new family (+25%).

In spite of being an important cause, day labor did not significantly affect the probability of being poor in either watershed. This may be explained by the fact that where families depend on day labor as a primary livelihood strategy, it seems to be associated with poverty. Where day labor is a complementary livelihood option, it can contribute to progress.

Accidents and illness were relatively rare among families in both watersheds, indicating that families are not as vulnerable as might be expected to external shocks. Rather, their challenge is to find and take advantage of opportunities. In Coello, failure to progress is due almost exclusively to bad habits or family problems⁷. This contrasts with SOP results from other countries, as mentioned in section 4. Though consistent with the relatively higher living standards in Colombia, such explanations should always be interpreted with caution since they may constitute superficial explanations for deeper problems that would not be recognized by the community. Lack of importance placed on illness suggests that indirect links between poverty and water quality via health are not important in these watersheds.

Again the results demonstrated the importance of off farm activities in successful livelihood strategies. Off farm employment, represented by stable jobs and by pensions were by far the biggest cause of poverty reduction. Also consistent with the diversification of livelihoods is the importance of family and friends, which may reflect the importance of contacts and social networks in obtaining off farm employment. The importance of education as a cause of poverty reduction may also be related to the higher skill levels required to get off farm jobs. In an SOP analysis in India Krishna (2006) failed to find a relationship between education and poverty reduction and interpreted it to mean in countries where institutional channels for providing information are weak, most of the off farm jobs are obtained via personal contacts. In Colombia, it seems that formal institutions are more developed, however informal contacts still play an important role.

⁶ In Coello, no agricultural households were ranked as poor in 2005. As a result, this analysis could not be done for each watershed separately.

⁷ In Coello, there were cases of families who had fled the zone due to political violence, but, because they were no longer in the community, they were not considered in the analysis.

While community participation was considered a critical aspect of wellbeing by communities in both Colombian watersheds, collective action was mentioned by just a handful of households as a reason for poverty or progress and was not significant in statistical analysis. This is consistent with the relative lack of importance of natural resource management in households' livelihood strategies. It may also reflect the underdevelopment of institutions for articulating local collective action with high scale decision making. Others have observed this lack of intermediate institutions in watershed management (FAO, 2006) and have hypothesized that such institutions may be critical to overcoming poverty traps more generally (Barrett and Swallow, 2006; Swallow et al, 2006).

Thus far in the analysis there is little evidence that the kinds of activities carried out within a watershed management program would have much potential to alleviate poverty. Improving the quantity or quality of water available to poor households—within ecological realities—would not, except in a few cases, make it more likely that they could engage in the livelihood strategies associated with prosperity. In other words, few win-win opportunities seem to be available.

Trade offs may be more likely. In the case of Coello, if limits were placed on cultivation of steep slopes to reduce erosion and associated agrochemical run off, poverty could actually increase since small scale production was a major escape from poverty for many households in Coello. Similar regulations in Fuquene may not increase poverty levels per se since many of the small farmers engaging in agriculture are already among the poorest, as are the day laborers who work on the potato farms in the paramos of Fuquene and the ranches and large-scale irrigated farms in Coello. While not increasing poverty, it could make the plight of the poor more difficult.

In both Fuquene and Coello, off farm income was the major way that households escaped poverty, and most of the sources of off farm employment are in agriculture- or natural-resource-based industries within the watershed. In Fuquene, mining was a very important source of employment, as was the large-scale dairy sector which generated jobs from farm administration to milking. One of the surprises in the follow-up interviews was the high number of female-household heads who got their families out of poverty milking cows on the dairy farms.

Small and medium scale agro-enterprises based on production of value-added dairy products such as cheese and yogurt were also common in Fuquene. The sale of services such as machinery rental to farmers and in the commercialization and/or transportation of agricultural products such as fruit, coffee or livestock were common in Fuquene and Coello.

Taken together, what these findings suggest is that while the poor are unlikely to obtain large benefits directly from improving watershed management, they could be hurt if changes in the rules governing how land and water are managed reduce the profitability of the agricultural and natural resource-based industries that generate employment and provide markets for products and services. A “do no harm” approach may be as or more appropriate than an explicit anti-poverty agenda in watershed management.

An implication of this finding for participatory watershed management programs is that interest groups may form along sectoral—mining, dairy, etc—lines rather than by

socioeconomic class. The concern that the poor will be doubly marginalized by being both geographically remote and disconnected from decision making may not be entirely warranted in these watersheds. The poor not concentrated in the remote upper reaches, and their interests can intersect with those of the better off.

Given that rich and poor within a sector may differ on how they would approach, for example, the need to make their industry more environmentally sustainable, it may not be sufficient to simply allow the rich to represent the sector. Rather, less powerful stakeholders need to be aware of the issues that unite as well as those that divide them, so that they can seek the best overall solutions. For example, the the rich and poor (or formerly poor) may be able to join together to effectively lobby the environmental authority not to impose harsh regulations. However another issue in the region is the increasing mechanization of milking, which could reduce employment and potentially aggravate poverty. It might be more strategic for those who might lose their jobs to try to link these two issues. In other words, the poor will still need to be able to participate in multi-stakeholder negotiations with other groups, however they need to have a much more sophisticated understanding of the which issues are most important to them, and how to identify and use potential allies most effectively.

Discussion

This paper looked at the role of water in the livelihoods of the poor in two Colombian watersheds, with the goal of identifying how poverty can be alleviated via better watershed management. The results suggest that while water is obviously a critical resource of any household, rich or poor, the opportunities to alleviate poverty by improving the quantity or quality of water available to poor households via better management of watershed resources may be limited. In terms of poverty reduction, the most successful livelihood strategies for getting households out of poverty over the last 25 years have been related to livelihood diversification and off farm employment. Interventions that increase the access of poor households to human and especially social capital will likely have a bigger impact on poverty than those that focus exclusively on natural or physical capital.

The study did find evidence of important indirect linkages between poverty and watershed management. The industries that generated employment for the poor also contribute to the environmental problems of the watershed. Thus, there is a potential for poverty-environment trade offs rather than win-win situations. Policy makers, planners and others who seek to intervene in watershed management in these watersheds need to be aware of the indirect linkages between poverty and the environmental via labor, product and service markets so that they can design programs that contribute to poverty alleviation where possible but, equally if not more important, do so without harming those who have managed to escape poverty, even if it was at the expense of the environment.

Colombian legislation allows for stakeholder participation in watershed management decisions. While it is increasingly recognized that stakeholder participation is an important part of integrated water resources management (IWRM), effective participation

presumes a good understanding of the issues, especially the socio-economic and biophysical linkages within watershed systems. Results from studies such as this one can contribute to improving the community knowledge base, and therefore to helping stakeholder groups better identify the issues that are important to them, and their potential allies in reaching their goals. The results of this study suggest that such interests are likely to follow sectoral divides, spanning the deep socio-economic and cultural divides that often exist in Andean watersheds. As such, they could be an important entry point into dealing with other more divisive issues.

Even though these results suggest that the poor are not a homogenous block whose interests are necessarily opposed to those of better-off groups, they do show that one thing the poor do have in common is that they tend not to participate in community level processes. Participation is considered to be a component of wellbeing, and in many communities the poor are identified as being those who do not participate. Building willingness and capacity of the poor to participate will not only improve the equity outcomes of participatory multi-stakeholder negotiation processes around watershed management; it will also have a direct impact on the welfare of the poor. In fact, this could well be the biggest direct impact that such programs have on the poor.

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Table 1: Sites where SOP methodology was implemented

Watershed/State	Municipality	Population	Communities surveyed
Fuquene/Cundinamarca	Tausa	7,715	Ladera Grande, Rasgata Baja
	Sutatausa	4,742	Chipaquin, palacio, Peñas de Cajon
	Guacheta	11,517	Gacha, La Isla, La Puntica
	Fuquene	5,214	Centro y Guata, Chinzaque, Nemoga
	Cucunaba	7,013	Chapala
	Carmen de Carupa	8491	Apartadero
	Coello/Tolima	Cajamarca	19,789
Ibague		498,401	Coello-COCORA, San Cristobal, Honduras
Espinal		76,226	Dindalito
Coello-COCORA		9,017	Potrerrillo, Chaguala Adentro
Rovira		21,665	La Ocera

Table 2: Stages below the poverty line, by order of importance (n=26)

Description	Order	Frequency
Food	1	23
Education	2	20
Clothing	3	15
Housing	4	18
Small Animals	5	18
Land	6	8
Services (water and electricity)	7	9
Appliances	8	10
Health	9	6
Crops	10	4
Other	11	2
Transportation	12	2

Savings/investment	13	2
Recreation	14	2

Table 3: Changes in poverty status from 1980 to 2005 (% of families per category)

Vereda	N	CatA Poor- poor	CatB Poor- not poor	CatC Not poor- poor	CatD Not poor- not poor	CatE New arrival
<i>Fuquene</i>						
Ladera Grande	53	66	8	17	4	6
Rasgata Bajo	41	24	22	2	5	46
Chipaquin	32	34	41	13	13	0
Palacio	59	37	47	0	2	14
Peñas de Cajón	69	17	61	0	0	22
Gacha	81	38	26	6	28	1
La Isla	92	40	30	3	25	1
La Puntita	90	39	32	0	4	24
Centro y Guata	82	90	1	0	1	7
Chinzaque	39	23	46	3	28	0
Nemogá	119	13	29	4	46	8
Chápala	86	83	13	0	0	5
Apartadero	43	30	70	0	0	0
TOTAL	886	42	30	3	14	10
<i>Coello</i>						
Apacra	13	0	31	0	69	0
El Rosal	13	0	77	8	15	0
La Alsalcia	14	21	57	0	21	0
Minidistrito La Leona	11	45	55	0	0	0
Cocora	18	6	22	0	44	28
Dindalito	26	15	46	8	31	0
San Cristóbal-Honduras	19	5	47	5	42	0
Potrerrillo	31	0	100	0	0	0
Chaguala	14	29	57	7	7	0
La Ocera	16	6	75	0	19	0
TOTAL	175	11	59	3	24	3

Table 4: Principal causes of change in poverty status (% of families)

Cause	Mentioned as first cause (n=361)	Mentioned as second cause (n=284)	Mentioned as third cause (n=133)	All (N=778)
Government help	7.5	4.9	14.3	7.7
Help of family and friends	9.4	16.2	8.3	11.7
Unexpected loss	0.3	0.0	0.8	0.3
Unexpected benefit	0.3	0.0	0.0	0.1
Education/training	1.9	3.5	8.3	3.6
Off farm employment	20.0	20.1	8.3	17.0
Day labor	7.8	9.9	5.3	8.1
Small or low quality landholding	0.8	0.7	0.8	0.8
Credit	0.6	2.5	3.0	1.7
Illness/accident	3.6	1.8	2.3	2.7
Large family	1.4	0.7	0.8	1.0
Small family	0.0	1.1	3.0	0.9
Newly established family	3.9	1.1	0.8	2.3
Agriculture	6.1	7.7	11.3	7.6
Livestock	1.7	3.2	8.3	3.3
Good money management	0.6	2.1	0.8	1.2
Bad habits	3.3	2.1	0.0	2.3
Legal or family problems	3.0	1.1	1.5	2.1
Inheritance	17.2	6.3	6.8	11.4
Savings/investment	3.3	10.6	9.8	7.1
Old age	0.8	0.4	0.0	0.5
Pension	4.4	2.1	2.3	3.2
Community work/collective action	0.6	1.4	3.0	1.3
Fishing	0.8	0.7	0.8	0.8
Migration	0.8	0.0	0.0	0.4
Total	100	100	100	100

Table 5: Principal causes of change in poverty status, Fuquene (% of families)

Causes	Mentioned as first cause (n=251)	Mentioned as second cause (n=187)	Mentioned as third cause (n=71)	% of all causes mentioned
Government help	6.4	4.8	7.0	5.9
Help of family and friends	8.4	15.0	9.9	11.0
Unexpected loss	0.0	0.0	1.4	0.2
Education/training	1.2	2.1	4.2	2.0
Off-farm employment	23.9	23.5	11.3	22.0
Day labor	7.2	8.0	4.2	7.1
Small or low quality landholding	0.4	1.1	1.4	0.8
Credit	0.0	0.0	4.2	0.6
Illness/accident	4.0	1.6	4.2	3.1
Large family	1.6	0.0	1.4	1.0
Small family	0.0	1.6	4.2	1.2
Newly established family	5.6	1.6	1.4	3.5
Agriculture	2.4	4.3	5.6	3.5
Livestock	0.8	3.2	8.5	2.8
Good money management	0.4	1.6	0.0	0.8
Bad habits	3.6	2.7	0.0	2.8
Legal or family problems	2.0	0.5	0.0	1.2
Inheritance	18.7	9.1	11.3	14.1
Savings/investment	3.6	14.4	14.1	9.0
Old age	1.2	0.5	0.0	0.8
Pension	6.0	3.2	4.2	4.7
Community work/collective action	0.4	0.0	0.0	0.2
Fishing	1.2	1.1	1.4	1.2
Migration	1.2		0.0	0.6
Total	100.0	100.0	100.0	100.0

Table 6: Principal causes of change in poverty status, Coello (% of families).

Causes	Mentioned as first cause (n=110)	Mentioned as second cause (n=97)	Mentioned as third cause (n=61)	% of all causes mentioned
Government help	10.0	5.2	5.2	7.1
Help of family and friends	11.8	18.6	18.6	15.8
Unexpected loss	0.9	0.0	0.0	0.4
Unexpected benefit	0.9	0.0	0.0	0.4
Education/training	3.6	6.2	6.2	5.1
Off-farm employment	10.9	12.4	12.4	11.8
Day labor	9.1	13.4	13.4	11.6
Small or low quality landholding	1.8	0.0	0.0	0.7
Credit	1.8	7.2	7.2	5.0
Illness/accident	2.7	2.1	2.1	2.3
Large families	0.9	2.1	2.1	1.6
Agriculture	14.5	14.4	14.4	14.5
Livestock	3.6	3.1	3.1	3.3
Good money management	0.9	3.1	3.1	2.2
Bad habits	2.7	1.0	1.0	1.7
Legal or family problems	5.5	2.1	2.1	3.5
Inheritance	13.6	1.0	1.0	6.2
Savings/investment	2.7	4.1	4.1	3.6
Pension	0.9	0.0	0.0	0.4
Community work/collective action	0.9	4.1	4.1	2.8
Total	100.0	100.0	100.0	100.0

Table 7: Number of causes by poverty category (% of families in category)

	A	B	C	D
1 cause	100	100	100	100
2 causes	62	89	48	84
3 causes	18	49	8	37
Sig X2 =				

Table 8: Impact of major causes of change in poverty status on whether household was poor in 2005 (n=359)

Cause	Coef.	Std. Err.	z	P> z	95% Conf. Interval		Mean
Fúquene	0.8294	0.2606	3.18	0.001	0.3185	1.3402	0.6953
Government help	-0.7866	0.2522	-3.12	0.002	-1.2809	-0.2923	0.1662
Help from family and friends	-0.8534	0.2246	-3.8	0	-1.2935	-0.4133	0.2521
Education	-1.2576	0.4380	-2.87	0.004	-2.1161	-0.3992	0.0776
Off-farm employment	-1.2735	0.1983	-6.42	0	-1.6621	-0.8849	0.3934
Health/accident	0.9861	0.4466	2.21	0.027	0.1108	1.8615	0.0582
New families	0.6794	0.4182	1.62	0.104	-0.1402	1.4990	0.0499
Agriculture	-1.8283	0.3797	-4.82	0	-2.5725	-1.0842	0.1634
Livestock	-1.0400	0.4285	-2.43	0.015	-1.8799	-0.2001	0.0720
Family problems	1.7996	0.7036	2.56	0.011	0.4207	3.1786	0.0443
Inheritance	-0.5756	0.2077	-2.77	0.006	-0.9827	-0.1684	0.2465
Savings and investment	-0.8336	0.2399	-3.48	0.001	-1.3037	-0.3635	0.1773
Pension	-1.3996	0.4045	-3.46	0.001	-2.1925	-0.6067	0.0693
Constant	0.3137	0.2703	1.16	0.246	-0.2162	0.8435	

LR chi square (13) 205.8, log likelihood = -128.48344, pseudo $R^2 = 0.4447$.

Table 9: Influence of cause on probability of being poor.

Cause	Delta $P(\text{Poor}=1)$ without cause (i) - $P(\text{Poor}=1)$ with cause (i)
Off farm employment	0.3650
Agriculture	0.3503
Government help	0.3041
Pension	0.2666
Education	0.2569
Help from family and friends	0.2343
Livestock	0.2310
Savings and investment	0.2182
Inheritance	0.1673
Fúquene	-0.2368
New families	-0.2517
Health/accident	-0.3706
Family problems	-0.6243

Figure 1. Fuquene watershed, Colombia.

Figure 2. Coello watershed, Colombia.