SANREM CRSP

SANREM CRSP RESEARCH BRIEF
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ABOUT
SANREM CRSP

SANREM'S mission is to assist in the analysis, creation and successful application of decision support methods, institutional innovations and local capacity approaches to support participatory sustainable agriculture and natural resource planning, management and policy analysis at local, municipal, provincial and national levels.

WATER RESOURCES MANAGEMENT AND WILLINGNESS TO PAY: THE CASE OF COTACACHI, ECUADOR

Can potable water and irrigation systems, which exploit water resources from a given watershed, contribute to the latter's sustainable management? Are rural households in developing countries willing to pay for improvements in the quality and reliability of water supplies? What are the key social and economic determinants for such willingness?

This study addresses the economics of water resource development, generally, and of watershed management, specifically. It seeks to determine what local people are willing to pay for improved performance of potable water and irrigation systems –particularly in the case of improved performance that would result from watershed conservation. In developing countries, the quantity and quality of water supplies are often inadequate. Water systems are often plagued by poor planning, which reflects erroneous assumptions about the needs and demands of rural populations. Moreover, in many areas there are no markets for water resources, and therefore no ways for evaluating costs and benefits of improved performance. Even where markets exist, as in Ecuador, prices are distorted by subsidies and other policies.

Price distortions in Ecuador undervalue irrigation water

Economists have developed methodologies for evaluating natural resources in the absence of price signals, including the technique known as contingent valuation (CV). CV calls for respondents to participate in simulated transactions in a hypothetical market setting. These transactions reveal what people are willing to pay for non-market goods and services provided by the natural environment. Applications of the methodology in various Asian, African and Latin American countries indicates that rural households are willing to pay an appreciable share of their modest earnings to improve access to

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and quality of their water supplies. CV is used in this study. In addition, a Linear Programming (LP) model of a typical subsistence farm has been developed in order to identify shadow prices for water and other resources used in crop and live-

Rural households are willing to pay more to improve potable water systems

stock production (shadow prices are indicators of the scarcity value of different resources, that is how much farmer would have to pay for marginal (i.e. small) increase in the availability of corresponding farm resource or input).

BACKGROUND

Cotacachi is located 105 kilometers north of Quito, Ecuador, in the Andean highlands of Imbabura province. Average annual precipitation is approximately 1300 mm, mostly falling between October and May. The mountainous area surrounding the town of Cotocachi hosts 41 indigenous communities, all of which belong to a federative organization known as Unión Organizaciones de Campesinos de Cotacachi (UNORCAC). Just northwest of Cotocachi lays the Cotacachi-Cayapas Ecological Reserve – one of the world's richest biodiversity hotspots, with an unusually high level of endemism (e.g., presence of species found nowhere else).

Cotacachi's major agricultural crops include maize, beans, and peas. Potatoes, barley, wheat and quinoa are also grown in the highlands, while at lower elevations some land is under pasture. In addition to subsistence crops, small holders are increasingly turning to production of vegetables (e.g., onions and cabbage) for local markets, while large farms are moving into export-oriented floriculture, which requires irrigation. Most households combine income from agriculture with off-farm employment, as construction workers in urban areas and as laborers on bigger farms. Only one third of households are exclusively dedicated to agriculture. Education levels are low, with many children dropping out of school before the seventh grade to join the family labor pool. More than one quarter of the population does not have any education, and another third did not go beyond elementary school. At least two members of each household are illiterate.

The declining quality and diminished reliability of water supplies for household and agricultural uses resulting from deforestation and erosion of the upper reaches of the drainage basin is an issue of serious concern to local people, most of whom depend on untreated mountain springs for drinking water. For example, among more than 300 water samples collected throughout the watershed as part of a study carried out by SANREM-AND and the Catholic University of Ecuador, 34 percent had concentrations of E. coli at levels that are unhealthy for human consumption (Duncan and Ruiz-Córdova, 2001[1]).

Deterioration of the water supplies is rooted in institutional as well as environmental changes. In 1995, the national government started to transfer the management of public irrigation systems to farmer-beneficiaries. The Consejo Nacional de Recursos Hidráulicos (CNRH) was created. Also, responsibilities for water resource development and watershed management were devolved to regional authorities, provincial and municipal governments, as well as rural communities. However, progress towards a more market-driven system continues to be hindered by subsidies for irrigation and potable water, which have been in place since the 1972 Water Law. Subsidies discourage the

development of water rights markets and reduce incentives for sustainable watershed management, since its outcome– expanded supplies of cleaner water – is depreciated by the state's policy of selling water at an artificially low price.

METHODOLOGY

To assess the value that Cotacachi's rural population attaches to potable water and to analyze factors influencing these values, 80 households were interviewed in September 2002. Half the sample is in communities below 3,200 meters elevation, which have access to irrigation. The other half resides in communities above this elevation level, where rainfed farming predominates. A survey elicited data on household demographic composition and social-economic status, labor availability and wages, income from agricultural or non-agricultural activities, prices of outputs and inputs, access to credit, and social capital (measured by participation in community meetings). In addition, the survey contained referendum-style CV questions in which improvements in the local water system and a stipulated price were proposed to the respondent, who was asked either to accept or to reject the proposal. Using the responses to CV questions as well as other survey data, we have undertaken econometric estimation of a model in which WTP for water quantity and quality improvements is the dependent variable and household earnings and proportion of income from off-farm employment are the independent variables**.**

Improved potable water and irrigation systems can contribute to watershed conservation

Also undertaken in this study was a Linear Programming (LP) analysis of a typical farm. LP analyzes ways to maximize farm net revenues, which equal product sales less cash expenditures on inputs, in the face of limited availability of land, water, labor and other resources. A profit-maximizing mix of production and employment levels is identified, as are the shadow prices for various farm resources and inputs. Each run of the LP model corresponds to a specific configuration of resource availabilities as well as market prices of inputs and outputs. In particular, LP analysis can be used to examine how production and employment are affected as a farm is given access to irrigation water.

The main objective of LP modeling and the CV analysis in this study is to estimate the value of water in order to inform policy proposals that can improve living standards in rural communities and provide incentives to conserve natural resources. The shadow prices obtained from the LP model provide guidance for policies to manage irrigation water. Likewise, CV estimates of WTP are important criteria in planning for investments in improved drinking water systems.

RESULTS

General LP Results

The LP model was run in two different settings, one a farm with irrigation water and the other a farm without irrigation water. Initially, the study included cattle and hogs competing for privately-owned land with other agricultural activities. However, farmers in Cotacachi generally use community land, in addition to their own fields, as a source of forage and therefore animals do not always compete with crop production for farm resources. The LP model's land constraint was modified to reflect this practice, which reduces the opportunity cost of livestock production by the farm family. The two representative farms, with and without irrigation, illustrate the general conditions of the majority of farmers in the study area.

Rents farmers pay for irrigated land are substantially higher than those for non-irrigated land, (respectively US$58.80 and US$48.60 per hectare). This difference relates to the higher crop yields and agricultural net returns in irrigated field. Yet farmers only pay a flat fee of $1.20 per farm per growing season to access irrigation, without any relationship to acreage or quantity of water used, even as irrigation increases the marginal price of their land by US$10.20 per hectare. This shows how undervalued water is in the region, this artificially low price for water being a result of heavy government subsidies.

Regression results

A key objective of this study was to know if communities are willing to pay for improving quality and reliability of their spring drinking water systems. The analysis reveals that most of households are willing to pay an average of US$ 1.84 to improve the quality and reliability of their system, which is about 50% more than what they are currently paying for drinking water.

Respondents' maximum willingness to pay was related positively to the income. As expected, people with higher incomes were willing to pay more to improve the quality of their drinking water. Family size also has a positive and statistically significant influence. This was also expected because the demand for water is higher in large households; as a result they would request increasing quality and reliability of the system and would be willing to pay to assure it. Other variables did not yield significant results.

CONCLUSIONS

Failure of government policies have led communities around Cotacachi to seek outside assistance to build their own drinking water systems. Responding to local communities' concern with water quality, this study sought to estimate if households would be willing to pay more for improving the drinking water system. The results showed that respondents of the ten communities that participated in this study were willing to pay more than they currently do. Econometric analysis revealed that the majority of households, in low-altitude communities as well as high-altitude settings, are willing to pay between $1 to $3 per month to make water supplies cleaner and more reliable – through improved watershed management, for example. This is a sizable payment relative to existing tariffs for potable and irrigation water. This study suggests that the costs of watershed management could be covered, at least in part, by capturing its associated local benefits. This has significant implications for the decentralization of water resource development, as is happening in Ecuador and several other Latin American countries.

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[1] Duncan, B. and S. Ruiz-Cordova. 2001. *Global Water Watch in the Andes*. In: SANREM CRSP Research Scientific Synthesis Conference. November 28-30, Athens, GA.

This brief draws from Fabian Rodriguez' Ph.D. dissertation, entitled "Local Resolution for Watershed Management: The Case of Water and Land Allocation in Cotacachi, Ecuador," School of Natural Resources, Ohio State University, Columbus, 2003.

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