Assessment of cloud deposition contribution to stream flows. Quantification of cloud interception by Paramo vegetation and other agricultural land covers in Fuquene watershed

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Though daily precipitation data of the past 10 years do not present any variation, the stream flows of Fuquene watershed are decreasing gradually. The lower levels of water stream can be caused by an increase of water demand for domestic use (aqueducts), higher evapotranspiration rates and a reduction of cloud interception as an important portion of the cloud forest and paramo ecosystem have disappeared. Water quantities used to supply aqueducts and evapotranspiration rates are measured in the field and with hydrological modeling. However, the hydrological impact of Paramo land cover changes towards agricultural uses is not fully documented. The conversion of Paramo to other land uses is speeding up at unknown rates. The impact of this change is also unknown and only by the use of modeling techniques is possible to obtain estimates.

To validate the different modeling scenarios it is important to collect field data in order to have direct observation to compare with. A monitoring campaign was set up for the surrounding Paramo of Fuquene watershed in which a climate station was installed and other hydrological information produced by the local authorities is being collected. Additional resources are being sought to install additional sensor throughout the area. With this information, it will be possible to know the effect of removing the natural vegetation and its conversion towards pastures and other crops on soils water retention and discharge in the nearby streams. This information is of vital importance to establish appropriate plans or guidelines in order to avoid environmental problems and conflicts in Paramo regions.

The collection of field data started at July 2004 and will continue until July 2005, in order to have enough information to assess the impact of land cover changes in the hydrological behavior of watershed.

Output 2. Determination of trade offs between environmental externalities and socioeconomic conditions in watersheds to evaluate alternatives and win-win scenarios where negative externalities are internalized

Output rationale:

The Andean mountains contribute to the quality of life and ecosystems in the nearby areas by providing environmental services. But despite a wealth of available natural resources, the welfare of the rural population has declined significantly over the last decade (Suárez 1999, López 1999). The region contains high levels of un- and underemployment due to, in part, decreases in agricultural product prices and rural sector investments. Difficult economic

conditions have forced many rural communities to over-exploit the natural resources. Such land use management strategies not only jeopardize the productivity of their own private lands (De Janvry and Glikman, 1991) but also cause detriment to surrounding areas. Many of these negative impacts or externalities are hydrological and costly. In Colombia, for example, sediment deposition and increased flooding cause damages of approximately USD 1 billion per year (Estrada 2002).

In the Andes, many environmental-economic trade offs exist. Although studies using experimental economic methods demonstrate that many users are willing to accept reduced short-term income in order to maintain the long-term ecosystems benefits (Cardenas 2000), there is a recognized need for policy development and implementation to foster more sustainable uses (e.g. minimum tillage, erosion control practices, etc).

Payment for the production of environmental services is, in theory, one of the few mechanisms left through which Andean hillside zones can combat current problems such as low agricultural prices, agricultural subsidies in developed countries, high rural underemployment rates, high levels of extreme poverty and degradation of the natural resource base. By making agricultural production viable and allowing profits to be captured locally, payment for environmental services schemes can have an impact on land use, food security and rural welfare.

Payment for environmental services is becoming an important topic in the Andean countries. Between 1994 and 2000, more than 5 million families spent over 140 million dollars on investments in watersheds to modify negative environmental externalities, the majority related to water and soil erosion (Contraloría General de la Republica, 2002). Though resources are available, the process of resource allocation has serious limitation, mainly related to the analysis and prioritization of alternatives that guarantee that: investment is made in areas with high potential for externalities, the agreed upon impact are achieved, payments represent a transfer of resources rather than a subsidy, and over time the benefits generated by payments are captured directly or indirectly by local producers, especially the poor.

“Andean Watersheds” Project has developed a methodology to analyze the alternatives and identify the ones that contribute to decrease environmental costs and increase rural welfare. Once the alternatives are selected its opportunity cost is determined and the externalities are valuated establishing its shadow price. These values are used to design and negotiate with stakeholders a mechanism of environmental service payment. Due to the ex ante analysis is based on watershed analysis, the finance mechanism is design according with the spatial causal relationships and therefore, the funds transfer goes straight to the producers that generate and modify the externality.

Milestones:

1. Productivity and profitability of different production systems and their impact on hydrological balances quantified.
2. Environmental externalities related with watersheds hydrological balances valuated under several lands use scenarios.
3. Opportunity cost of land use alternatives calculated.
4. Costs and benefits for society of the new land use alternatives valuated.