Ex ante evaluation of land use alternatives to internalize environmental externalities and increase rural welfare. Evaluation and selection of land uses for the prioritized URH in Fuquene watershed by its environmental and socioeconomic impact

Rubén Darío Estrada[1], **Marcela Quintero**[1, 2], **Ernesto Girón**[1, 2]
[1] *Consorcio para el Desarrollo Sostenible de Ecorregión Andina (CONDESAN), Apartado Aereo 6713, Cali, Colombia.*
[2] *Centro Internacional de Agricultura Tropical (CIAT). Apartado Aereo 6713, Cali, Colombia.*

Introduction

Conventional analysis of production systems do not used to consider hydrological balances or environmental externalities in determining optimal land uses. Instead, this analysis used results from HRUs analysis (output 1) for Fuquene watershed. Specific HRUs were prioritized according to their potential to contribute positively to environmental and social (relate with profit distribution) externalities.

The URH prioritization is needed because the effect of land uses on sediments, N and P production to the lake is not homogeneous in the whole watershed. The externality magnitude generated by a specific point in the watershed is different to the magnitude of the same externality but generated in other watershed point. This is quit obvious in Andean watersheds where the relief, soils, land cover and precipitation variations produce different combined effects on externalities.

For that reason, evaluation of land uses is conducted in the watershed sites that are previously prioritized by its important nutrients and sediments contribution to the Fuquene Lake. These sites are the URH that under current land use scenarios are producing highest rates of sediments. This criteria is not related only with the effect on sedimentation process itself but with the contribution to aquatic vegetation growth, which require N and P contained in the sediments. Most P found in soils does not infiltrate through soils profiles and instead, remains in the topsoil. When runoff picks occurs the P is incorporated to the solution and the eroded material that moves downstream. In the case of N, one part is loss with runoff phenomenon and other one get infiltrated and is moved through lateral flows until it reaches main streams.

Preliminary results:

Land uses and management practices evaluated in the prioritized URH correspond to the current land use scenario and three potential scenarios. The impact of current land use scenario was assessed with two main purposes: First, assure that the model performance is logic as its results are consistent with reality. Second, identify and quantify the current impact of land uses in order to provide a basis to calculate marginal changes of externalities by implementation of potential scenarios (land use changes, regulation, rules, etc). For the current scenario, the impact of production systems with conventional tillage and high applications of fertilizers was quantified.

The potential scenarios modeled and evaluated were: A) the impact of external regulation that controls the sediment production and therefore, influence on the crop area using conventional tillage. B) The impact of adoption of minimum tillage, direct drilling and incorporation of green manures practices in the production systems. C) The impact of a farmer payment for each ton of sediments produced to the lake. This payment will cover the cost of sediments extraction from the lake.

The three potential scenarios results were compared with the impact of current land use scenario according with their environmental impact on the lake, the economic impact on net incomes and the employment generation in the watershed.

The adoption of minimum tillage, direct drilling and incorporation of green manures practices (scenario B) will have a substantial impact due to the reduction of about 70% of the current sediments, N and P production, and the increase of farmers net incomes. In this sense, there is not opportunity cost of changing current land use to minimum tillage practices but some transaction cost must be assumed to promote technological change.

The scenario that implies an external regulation (A) to punish high levels of sediments, N and P production; cause a detriment on net income despite the marginal change in environmental externalities is positive. For this case, efficient authority monitoring mechanism was assumed. Scenario C, farmers adopted minimum tillage in their production systems in order to lessen the payment of assuming the environmental cost. In this scenario the opportunity cost is zero because the increment in net incomes. However, the transaction costs to guarantee the proper execution of payments can be higher than the transaction cost of the technological change itself. In the output 3 and 4 is explained how these changes in management practices are stimulated through collective action and strategic alliances in Fuquene watershed.