Reducing nutrient loads by providing soft loans, Fúquene Lake, Colombia

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Short title: PES-type scheme in Fúquene lake, Colombia

Key Message: Access to loans from a revolving fund encouraged farmers to switch from conventional to conservation agriculture in order to reduce chemical and organic loads to the Fúquene lake and diminish its eutrophication.

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1. What was the problem?

Fúquene Lake (Laguna de Fúquene) catchment in Colombia is an area of intensive cattle production and agriculture (Porras and Neves 2006). The majority of the population in the upstream areas earns their livelihood from traditional potato growing. Cattle ranchers that manage intensive grazing are mostly located in the mid-range of the slopes (Cardenas et al 2006).

As most of the Fúquene Lake watershed area is used for agricultural crop production and pasture, land degradation is a serious concern (Johnson et al 2009). The catchment is increasingly exposed to heavy degradation such as great loss of top soil due to erosion processes, sedimentation, increased levels of nitrogen and phosphorus from fertilizers, reduction in the lake's storage capacity and reduced levels of dissolved oxygen - thereby threatening the lake with eutrophication (Porras and Neves 2006).

The Andean Watershed Regional Project, sponsored by the German Technical Cooperation and the CGIAR Challenge Program on Water and Food (CPWF) and implemented by GIZ, CONDESAN (Consortium for Sustainable Development of the Andean Eco region) and CIAT (International Center for Tropical Agriculture) , chose the Fúquene Lake in Colombia, among other cases in the Andean Region, to carry out sustainable development projects (Blanco 2006), using as an entry point the positive environmental externalities.

2. Which ecosystem services were examined and how?

The ecosystem services tackled are primarily *Provisioning fresh water*, *Regulating waste water treatment* and *Regulating soil erosion and fertility,* specifically the retention of sediments and nutrients (i.e. phosphates, nitrates and ammonia).

The overall aim of the project is to reduce nutrient loads in the Fúquene Lake by helping farmers to access soft loans to improve their agriculture practices and switch to more environmentally friendly methods (Porras and Neves 2006:1), e.g. conservation tillage.

The project was implemented in three steps (Blanco 2006).

Step 1: Detection and quantification of Fúquene Lake deterioration sources.

Based on biophysical information, the modeling system SWAT (Soil and Water Assessment Tool) was used to identify relationships among land use, water quality and quantity and sedimentation. With this modeling system, the lake eutrophication problem, caused by sedimentation, and nutrients losses (nitrogen and phosphor) derived from agricultural and livestock practices, were analyzed (Blanco 2006). Also, N-isotopes were used to trace these elements in the water and determine their sources (Rubiano et al. 2006).

Step 2: Comparative modeling of conventional agriculture vs. conservation agriculture:

Step 2 compared the modeled effects of conventional agriculture as opposed to conservation agriculture methods with regard to negative effects on the lake. The calculation included the change on rural producers' net income, employment creation, as well as the changes in sedimentation generation and water filtration for two different scenarios: conventional and conservation agriculture (Quintero and Otero 2006).

The three main principles of conservation agriculture are (summarized from Quintero and Otero 2006:9):

(1) Crop rotation with cover crops:
"Cover crops" are species which are planted in rotation with commercial crops to reduce plague occurrence in commercial crops. Additionally, the vegetation cover helps to maintain humidity, reduce soil erosion and to improve physical and chemical characteristics of the soil.

(2) Permanent soil cover:
The soil stays covered through the organic residues from the cover crop.

(3) Minimum mechanical soil disturbance (reduced tillage):
To maintain soil structure and to avoid destroying the organic matter, farmers avoid intensive soil preparation practices when planting new crops.

According to the results of the model, the rural producers' net income would increase by 18 - 25% under conservation agriculture, which at the same time reduces sedimentation by an estimated 50 -70%. However, in the upper watershed the employment rate would drop by about 14% due to the reduction of working days in soil preparation under conservation agriculture. This reduction again would be opposed by an increase of 62% in the employment rate in the middle watershed, where the improvement of soil conditions would shorten the periods between crops (Quintero and Otero 2006).

Tables 1 and 2 show the values calculated for the upper and middle watershed respectively:

	Scenario 1 Conventional agriculture	Scenario 2 Conservation agriculture	Marginal changes
Net income (USD)	1662223	1975922	313699
Sediment (ton)	72422	43761	-28661
Water production (m3)	174690	710960	536270
Employment (No. Of working days)	79067	67753	-11314
Environmental, economic and social benefits	2174964	3048756	873791

Table 1 - Scenarios analysis for potatoes producers in the Fúquene's upper watershed (166.5 ha. prioritized). Note: the values correspond to a 5 year period. Calculation of social benefits: sediment costs = $15/ton, water = $ 0.05/m^3, labor multiplier effect per working day = 0.5, multiplier effect per income = 0.6. (Quintero and Otero 2006:18).

	Scenario 1 Conventional agriculture	Scenario 2 Conservation agriculture	Marginal changes
Net income (USD)	1223820	1235716	11896
Sediment (ton)	95414	48730	-46684
Water production (m3)	146490	876770	730280
Employment (No. Of working days)	43576	70714	27138
Environmental, economic and social benefits	861046	1820389	959342

Table 2 - Scenarios analysis for cereal and potatoes producers in Fúquene's middle watershed (162.5 ha. prioritized). Note: the values correspond to a 5 year period. Calculation of social benefits: sediment costs = $15/ton, water = $ 0.05/m^3, labor multiplier effect per working day = 0.5, multiplier effect per income = 0.6. Source: (Quintero and Otero 2006:18).

Step 3: Designing a financing mechanism to facilitate credits for the initial investment costs of conservation agriculture implementation:

Based on the results of Step 1 and 2, the project designed a financing mechanism in cooperation with two rural producers associations, the Andean Watershed Project of GTZ-CONDESAN and the Ford Foundation - Colombia. The financing mechanism aims at facilitating taking credits for the initial investment costs of conservation agriculture measures, which cannot be covered by small rural producers' cash flow (Quintero and Otero 2006).

3. Did the examination of ecosystem services generate impacts on decision-making or policies and, if so, how?

The financing mechanism for conservational farming, which began to work in 2004, is based on a revolving fund administrated by the rural producers associations. Its funds come from the Andean Watershed Regional Project and the Ford Foundation with a total amount of 55,000 USD. The credits are assigned to small farms no larger than 2 ha and have to be paid within a period of eleven months, during which the producers have already harvested their crops (Quintero and Otero 2006).

To ensure credibility and continuity of the conservation measures, the farms are subject to a monitoring mechanism (Quintero and Otero 2006):

- *Before obtaining the contract*, verification of the crop planting methods by a conservation agriculture extension agent is compulsory.

- *After establishing the conservation agriculture measures*, information about the effective delivery of the ecosystem services is obtained through a monitoring mechanism. It has three main components:
    1. Geographic position of the farms that are including cover crops (e.g. oats) in their rotations;
    2. Modeling the hydrological impact in terms of sediment loads of areas applying conservation agriculture;
    3. In situ measures of soil variables regarding water infiltration, retention and water runoff.

At the time of the report (2006) the information for the monitoring system was being collected. However, the project planned to adjust and modify the monitoring system to have information available at lower costs. Currently, these impacts are being measured through established controlled plots where impacts on soil and nutrient losses via runoff are monitored.

According to the project evaluation in 2006, 107 rural producers obtained credits for implementing conservation agriculture. Additionally, the project offers to the members of rural producers associations training on accountability, administration, and organizational strengthening. Furthermore, the regional environmental authority provides technical advice and extension services for the project (Quintero and Otero 2006).

4. Lessons learned

As crucial factors facilitating the project were identified the alliance between research and development; the prior experiences promoting conservation agriculture in the watershed; the presence of rural producers associations; the environmental awareness of the farmers; and the trust relationship established from the beginning of the process.

The analysis of watershed biophysical responses permitted the identification of concrete measures to improve land uses and diminish the adverse effects on the ecosystem services of the lake. This analysis in combination with a funding mechanism, which facilitates the implementation of conservation agriculture, made Fúquene's case a successful one.

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