Case study:
Argentina: Rural planning and sustainable water resources use in Pillahuinco basin (#443)

Description
The Pillahuinco basin is located in one of the most productive regions of Argentina. It is within the roads that connect the southernmost parts of the country with the capital and the far north, as well as the Andean provinces of the west with the ports of the Atlantic coast, intersect there. The basin covers a region with a distinct topography, presenting a highland area with elevations between 250 and 650 meters. With a plain that can reach about 125 meters where agricultural activities predominate. The agriculture activities have resulted to environmental problems calling for an approach that can provide solutions to support sustainable development of the basin.

The major problem in the basin is surface water erosion causing a loss of soil productivity in the upper catchment of the basin. This results to flooding in the middle and lower basin. Therefore, there a need to design a planning program aimed to reduce soil loss by surface water erosion and thus increase soil productivity, strengthening the hydrological dynamics in the Pillahuinco basin.

Action taken
A collaboration among the residents of the basin was initiated to address soil loss through surface water erosion. Indicators were developed that identified the everyday use and management values through involvement of stakeholders in the basin. The approach enabled easy interpretation and provided a basis for comparative analysis of every resource user. Thus, consensus and the support of the basin stakeholders with diverse representation from private sector, political, institutional and social background was cemented. The implementation of this program highlighted a case in rural planning that has contributed to the improvement of the quality of life of the rural and urban communities.

In addition, quantification and modelling of water resources was done through the application of geographic information systems. It was crucial so as to assess the availability of the current and future resources as well as analysis of land use changes. The end product is a geospatial database available and open to public access.

Finally, a sustainable use of water resources and Rural Planning for the basin was proposed based on potential alternative production systems. The proposal has taken into account the needs of the local population and the implementation of Land Use Planning that can be achieved through integrated water resources management.

Lessons learnt
The sustainable use of water resources and rural planning in the Pillahuinco basin was an important experience for integrated water resource management. It involved different stakeholders in the basin, implementing sustainable farming practices that aim to address surface water erosion, and to recover the productivity of the soil.

The joint action of the project participants (researchers, producers, public and private institutions as well as other stakeholders) made it possible to collect field data on biological, productive, environmental and social features of the basin under study.

Main Text

In Pillahuinco basin, economic growth has been historically associated with agricultural and livestock production. Agricultural production accounts for 50 % of the production in the district. The main crops grown are wheat, soybean, barley, sunflower, sorghum and maize. 70 % of the production is exported.

Human activities in Pillahuinco basin resulted to a number of issues that arise from irrational use of natural resources. Loss of soil productivity and degradation, erosion, floods, desertification, water eutrophication, destruction of forests and loss of biodiversity have become evident in the basin. These problems make living conditions difficult for residents of the basin forcing many to migrate to big cities in search of better life.

Methodology for problem identification
The following criteria were used to identify the problems in Pillahuinco basin.

- Direct action of water erosion from torrential rainfall through channelled runoff in the upper basin (Figure 1)
- Negative environmental impact from floods in the middle and lower basin (Figure 2). This results to damage to the communities' property.

Figure 1. Soil loss by surface water erosion

Figure 2. Flooded urban area

The floods have a direct effect on the quality and quantity of water available. Therefore to find lasting solutions to the problems in the basin, there was a need for technical and cultural knowledge dissemination. This focused on the dynamics of water resources in urban and rural population, public and private institutions, regarding:

- Causes of soil loss by actual and potential erosion, in quality (type) and quantity (class, grade, granulometry, nutrients (cause of loss), leaching, deep percolation, channel runoff, water table runoff).
- Loss of actual and potential productivity of the river basin, expressed in indicators and everyday use and management values employed by stakeholders in the basin. Such information has enable easy interpretation for comparative analysis for each group of stakeholders.
- Quality of existing water resources, such as the current and future availability, chemical and physical quality, capacity, transport energy, sediments and other diverse elements.
- The flood wave dynamic, before and after land use planning, establishing the delay time, potential reduction of water flow (of the different types of distinctive flows), decrease in the intensity of floods.

The present project was crucial for the sustainable management of Pillahuinco river basin and its main tributary of Quequén Salado River. The whole catchment provide water supply for both human consumption, agriculture and tourism in this vast region as seen figure 3.

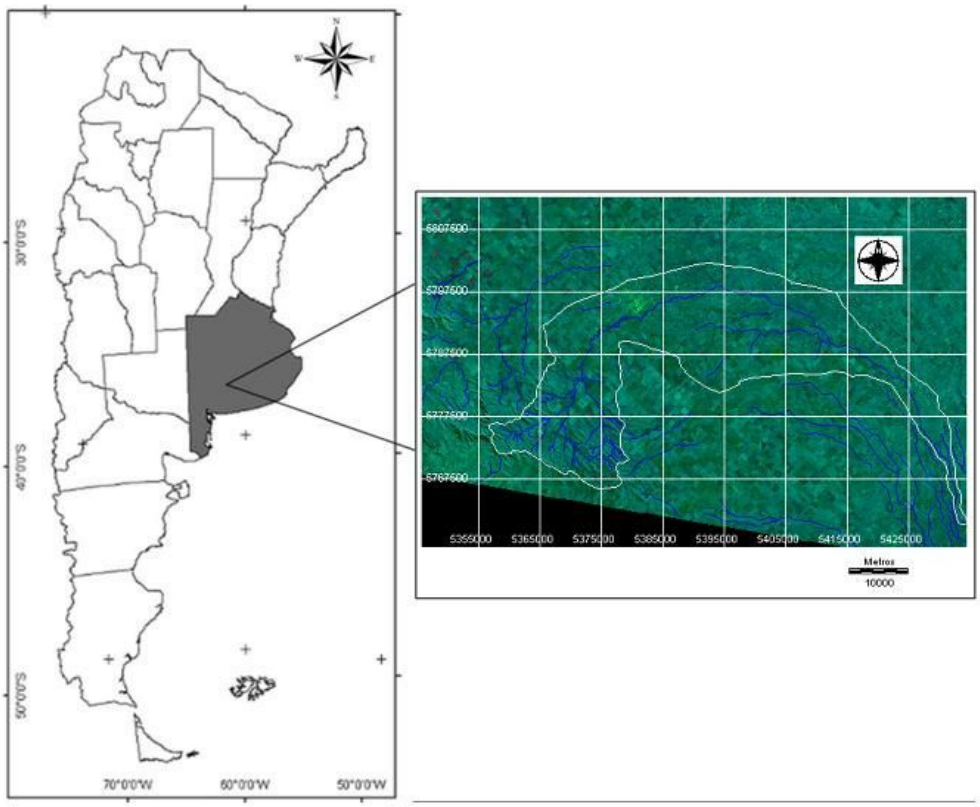

Figure 3. Location of Pillahuinco basin.

The basin is located in one of the most productive regions of Argentina. The roads that connect the southernmost parts of the country with the capital and the far north, as well as the Andean provinces of the west with the ports of the Atlantic coast, intersect there. The basin covers a region with a distinct topographic dimorphism, presenting a highland area with elevations between 250 and 650 meters, and a plain that can reach about 125 meters, where agricultural activities predominate as seen in figure 4.

Figure 4. Basin Environments

Action taken and results achieved

As a result of the complexity of the basin and the wide range of issues involved a management system has been put in place that encompasses an approach with high stakeholder participation including local institutions. The approach is considered useful tool in addressing complex problems. In concrete terms, a rural planning pilot project was initiated to improve the quality of life of the rural communities living in the basin. The Pillahuinco river basin and

management unit and the agro hydrological administration comprised of the main watercourse with its tributaries and the entire watershed. Being a productive natural system where humans interact with the resources in the basin, harmonizing the potentials exploitation activities for sustainable use is vital. Managing such a river basin with heavy human exploitation must take into account all the key elements present in each river system, such as water, soil, forests, crops, hills and valleys. To achieve this, there is need to involve all technical and social disciplines and many different institutional sectors agencies. This manner of planning and management of a basin is essential for understanding and applying the proper procedures for use and management of natural resources. It played a great role for setting up a methodology to develop a land use plan for Pillahuinco river basin.

A model for watershed planning action was produced. It includes, a cartographic model that helps to carry out geospatial monitoring of the diverse physical, biological and social aspects in the river basin. A joint georeferenced database or GIS (Geographic Information System) that researchers used to determine in both qualitative and quantitative manner the water dynamics in the basin was also produced. The basin was further zoned with the data retrieved, in line with suitability and capacity of soil use as seen in figure 5.

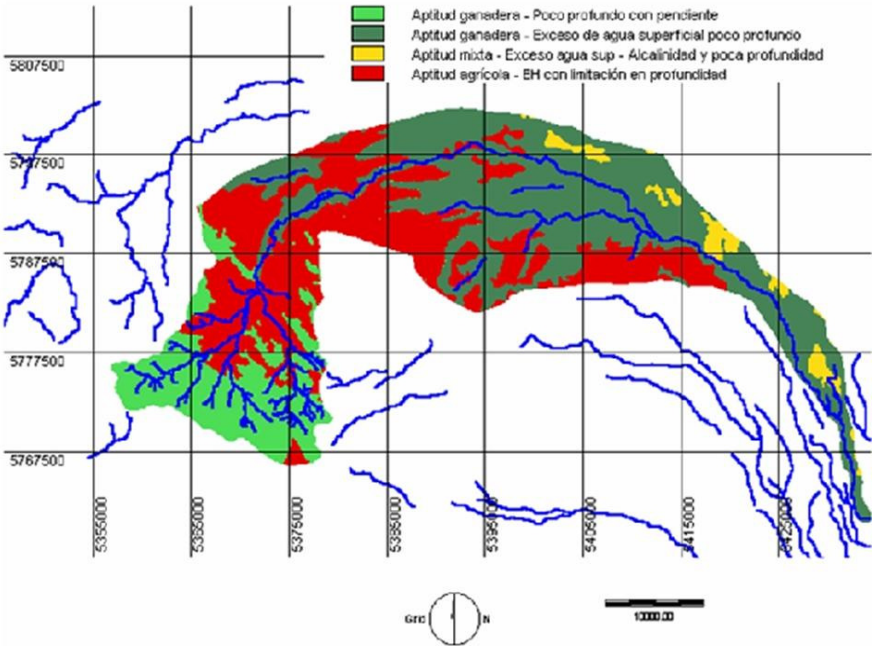

Figure 5. Zoning of the basin in relation to suitability and capacity of soil use. Light green and green: Livestock. Yellow: Livestock and Agriculture. Red: Agriculture.

The processing of this database enabled a qualitative classification for the assessment which is meant for planning of agriculture and forestry production. This helps in defining priority areas of action and establishing a particular database available in:
http://www.agro.unlp.edu.ar/owncloud/public.php?service=files&t=37e268dfdd43a16c2b6b2c11e724741c
A study water dynamics conducted at the same time as the planning process to determine the soil loss through the application of the Universal Soil Loss Equation (USLE) and its modification for river basins. The results displayed a loss in the basin of approximately 620 megagrams/hectare per year, reaching 18 megagrams/hectare in heavy rainfall situations. These soil loss values are high in comparison with similar study done by FAO in the late 1980s.

In order to reduce the magnitude and intensity of erosion in the basin soil management

measures were implemented. These include soil water management techniques such as strip cropping and contour farming, use of terraces in areas with important slopes. More so, reduction of the number of animals per hectare, placement of drinking troughs for livestock to prevent animals traveling to river banks.

As for productive activities, afforestation plan was implemented by the Production and Cooperativism Office of the municipality. Producers were given seedlings of *Eucalyptus viminalis* intended as tree curtains, to provide shade for the cattle and forest cover for the upland areas of the basin. The municipality started the construction of the municipal nursery, and its production will be destined to the development of the Pillahuinco river basin. These actions carried out by the municipality and different NGOs created employment for residents both in rural areas as well as in the surrounding cities of the basin.

The land planning proposal presented here is in line with the efforts of the municipal government to generate productive activities such as sheep farming, beekeeping, horticulture and industrial activity. The group of researchers' part of the planning process recommended the implementation of actions aimed at the reduction of damage resulting from anthropic activities and among which are below actions:

- improved surface coverage,
- implementing conservation techniques in soil water management,
- zoning critical areas,
- planning of drainage systems,
- construction of infrastructure works etc.

Regarding the natural causes (tectonic, climatic, geomorphological and hydrological related) measures to reduce their magnitude and intensity were also recommended.

- weather forecast,
- rational use of water,
- forecasting of drought periods,
- Construction of windbreakers.

A series of workshops were organised to exchange ideas and views with stakeholders. The categories of participants included members of the Rural Society of Coronel Pringles, individual producers, professionals from the Centre of Agronomists and the Veterinarian Circle, government agencies as well as NGOs. The strategy of action that came forward and recommendation from the workshops, was to broaden the conservation practices used in critical areas of the basin. Also, to ensure controlled livestock access or no access to watercourses, implant pastures, regulate the proper load of cattle according to the characteristics of the batches, crop rotation, define fallow periods and conservation tillage.

The residents of the basin were trained at the workshops with skills on implementation of soil conservation practices and proper management of vegetation cover. The implementation of these activities can reduce soil loss by surface water erosion increasing soil productivity. Other measures of land planning recommended, particularly for the upper area of the basin, were the execution of structural works of hydrotechnical type (small infrastructure works for torrent control) for sediment retention. As a supplementary step, different measures of soil and vegetation cover management regarding site conditions in areas of contribution to the structural work were also recommended. For example, afforestation with fast growing tree species was proposed for the gorge area of the basin. In this regard, workshops were organised to train residents on issues to incorporate silviculture.

In order to achieve the proposed goals, an agreement was signed between the National University of La Plata and the municipality of Coronel Pringles. The agreement acted as a basis for commitment from different institutions to collaborate with rural planning at basin level. It included the Rural Society of Coronel Pringles, Producers Association, Road cooperative and centre of Agronomists.

Institutional mechanisms for collaboration and coordination with municipalities were established, which entail the resolution of issues closely related to the management of water resources, such as recurring flooding of the urban centre of Coronel Pringles.

Coronel Pringles joined the Intermunicipal Consortium for Regional Development (CIDERE), which recently inaugurated the Regional Development Agency (ADR). It aims to promote strategic sector alliances, coordinate public and private efforts to foster development in the region, promotion of cooperation and employment generation as well as social, economic and environmental sustainability.

Lessons learnt

Indicators and values of everyday use/management were defined and adopted by the stakeholders in the basin and their experiences were displayed to the community in workshops. This experience facilitated the easy interpretation and/or comparative analysis for each basin user (stakeholders).

Consensus and support of the basin stakeholders was valuable despite their different representation.

The need to improve the supply of water in the region to promote the quality of life of the inhabitants must be met integrating rural and urban populations in the tasks required for sustainable territorial development. Each training conducted and proposed actions were all achieved through consensus among the diverse stakeholders, such as government authorities and small agricultural producers, through which differences between those involved were reconciled, facilitating joint activities.

The rural land planning was successful done with the support of river basin stakeholders in their various representative sectors: productive, political, institutional (public: INTA, Rural Society, hospital, schools; and private: cooperative associations, producer groups) and social in general.

The methodology developed in this work can be replicated in other areas with similar issues, particularly in the highlands of Buenos Aires. The commitment of stakeholders to implement measures to reduce soil degradation is essential.

Importance of the case for IWRM

Rural planning and sustainable exploitation of water resources in the stream basin of Pillahuinco was an important experience for the management of water resources as it involved diverse stakeholders in the basin, in order to advance sustainable farming practices that will enable the reduction of surface water erosion, recovering soil productivity. The implementation of these measures can mitigate the demands expressed by the population of Coronel Pringles.

In order to mitigate the recurrence of floods experienced by the urban area of the city the adoption of measures that go beyond property level and involving all the constituent

stakeholders of the basin Pillahuinco is required, focused on the control of runoff in the upper basin, through the implementation of the proposed land use planning.

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