Cooperation on Water management issues, Argentina

Project in the framework of Bilateral Cooperation between Argentina and the Netherlands

Case studies on water management issues in Argentina

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1. Introduction

In Argentina parts of the country have problems encountered from too much water or suffer serious water shortages. The Humid Pampas encounter an increased rainfall since the 1970's. In Mendoza Province water resources are limited and all the water from the rivers is used for agriculture, drinking water and industries. For the management of such systems an integrated approach is needed, where hydrological modelling tools can be used to support decision making.

The shortage of water

The Province of Mendoza contains more than twenty percent of the total irrigated land in Argentina. As the annual average rainfall is approximately 200 mm, irrigation is crucial for agriculture. The rivers that collect the snowmelt water of the Andes mountains are the most important water resource. Storage dams were constructed to guarantee the irrigation demands over the year, but their impact on the long term are unknown. Environmental conflicts in the irrigated areas are becoming more seriously.

In the bilateral cooperation project mitigation measures will be analysed using the SIMGRO water management tool. The measures focus on the improvement of the irrigation efficiency.

For further details see Chapter 2 on the analysis of water use in the Mendoza irrigated area and as an example the model use in an irrigated area.

Excess of rain water in the Pampas

Since the 1970's, rainfall has considerably increased in the Pampas. This increase in rainfall regime has resulted in flooding. Lakes were formed spontaneously and cities were threatened. A recent spell of wet years has increased the problem drastically. By November 2001, about 5.5 million km^2 of agricultural land was flooded or semi-permanently waterlogged, resulting in 900 million dollars losses and disrupting rural life for years to come.

The problems encountered in the Pampas of Argentina require an integrated approach. Technical measures such as building drainage canals should be combined with measures at the local and catchment scales. The construction of drainage canals alone will not be effective for the large areas under flooding and with high groundwater levels. Adoption of mitigation measures at the farm and catchment scale should contribute to this feasibility in a large extent.

In the bilateral cooperation project mitigation measures will be analysed using the SIMGRO water management tool.

For further details see Chapter 3 on the flood control in the Pampas.

SIMGRO, a water management tool

Simulation models of hydrologic and irrigation management should be able to identify solutions to the water problems such as occurring in Argentina. They can support decision-making on water management and their advantage is that they can be used in situations with changing conditions affecting the hydrologic system. It is important to simulate the water management situation as accurately as possible and to include operational practice. The traditional drawback to a modelling approach has been the large amounts of reliable input data required, but nowadays GIS data can be used, making models easier to use.

For further details see Chapter 4 on the Simgro modelling tool and an example the model use for an irrigated area in the Province of Mendoza.

2. The analysis of water use in the Mendoza irrigated area

Keywords	Hydrologic model, irrigation, performance indicators, salinization, groundwater, surface water, evapotranspiration, drainage
Target groups	Provincial Authority of Mendoza; General Department of Irrigation, Mendoza; Water user associations, Natural Resources Office.
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<u>Introduction</u>

The irrigated area worldwide currently exceeds 272 million ha and is continuing to expand. The irrigated areas play a vital role in economic and social development, yet it is well known that often they do not function efficiently. Many factors contribute to the shortcomings responsible for the poor efficiency of irrigation systems: for example, inflexibility and a lack of knowledge about the match between water delivery and water requirements. Future water shortages will probably mean less water is available for agriculture, making it essential for irrigation areas to be operated more efficiently, producing more from the same amount of water: “more crop per drop”. To be able to improve the efficiency, its important to understand the interaction between irrigation and drainage. This must be studied in sufficient detail to identify operational guidelines for the different hydrologic situations in an irrigation system. Numeric simulation models can provide useful support, as they enable specific operational procedures of irrigation and drainage conditions to be evaluated. Unfortunately, the complexity of the irrigation system – the conjunctive use of surface water and groundwater – is often a deterrent to their use. Adding to the complexity is rotational water delivery to irrigated units.

Though only 800 km^2 in area, the Mendoza River basin has a population of over 800,000; 25% of its water is used for domestic and industrial purposes, while the remainder is used for irrigation. The main crops grown are grapes, fruit trees, olives, summer and winter vegetables, and grass. The irrigated infrastructure started to develop about a hundred years ago. The decentralized and participatory management model for the irrigation management that has been in force since the outset has proved to be inefficient in terms of water distribution, maintenance and, above all, water use control. The mean irrigation application efficiency is considered to be poor, being 59%. The salinity in the upper soil of irrigated crops ranges from 1 to 5 dS/m).

<u>Highlights</u>

The application of regional hydrologic models of surface water and groundwater to an irrigated area in Mendoza Province, Argentina has shown that the advantage of a model, such as SIMGRO, is a powerful tool to evaluate water management measures. The model can be used in situations where changing conditions affect the hydrologic system, in which the interaction between groundwater and surface water system is important. Irrigation practice can be simulated in time for a number of years with changing meteorological conditions and irrigation applications. Different kinds of scenarios can be simulated relatively easily and accurately. For instance, the model will predict the effects that may be caused by changes in surface water and groundwater allocation or a change in the irrigation and drainage infrastructure. An important aspect is the need to simulate the hydrologic processes and salt transport as accurately as possible and to include operational irrigation practice. The drawback of such a modeling approach is the great demand for reliable input data.

The two indicators, relative evapotranspiration and depleted fraction, enable a scenario to be evaluated objectively. An examination of trends in these performance indicators will increase the understanding of the constraints of an irrigation system. On the basis of the evaluation of the indicators, improvements to the irrigation infrastructure can be designed, or the management can be improved. The modeling of a solute transport of a conservative substance is useful for evaluating measures to control salinity.

Further readings

Morábito, J.A., E.P. Querner and D. Tozzi, 2005. Using performance indicators for the analysis of water use in the Mendoza irrigated area. In: Sustainability of Groundwater Resources and its Indicators. Proc of Symp. S3, IAHS Scientific Assembly, Foz do Iguaçu, Brazil, April 2005. IAHS Publ. 302. pp. 126-133.

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Interesting links

INA, Instituto Nacional del Agua:	www.ina.gov.ar
Universidad Nacional de Cuyo:	www.uncu.edu.ar
Facultad de Ciencias Agrarias de la UNCuyo:	www.fca.uncu.edu.ar
General Department of Irrigation, Mendoza:	www.irrigacion.gov.ar
Instituto de Desarrollo Rural	www.idr.org.ar
Asociación de Inspecciones de Cauces (WUA):	www.asicprimerazona.com.ar

3. Evaluation of Mitigation Measures to reduce Flooding in the Pampas, Argentina

Keywords	Flooding, mitigation measures, forestation, increased rainfall, actual evapotranspiration, comparative water use
Target groups	Farmers, Provincial Authorities, Ministry of Social Development, National Under Secretariat of Water Resources

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Introduction

Eight million hectares of agricultural lands in the north-western part of Buenos Aires Province are subject to periodical flooding and suffer from droughts. Flooding recovery is a very slow process because the inadequate drainage system, being associated with the flat lands. After four flooding events since 1998, farmers and inhabitants are moving to larger cities, as they are unable to cope with heavy damages in infrastructure and losses in production. Also areas are isolated as some roads are nearly permanently closed because of flooding. INTA, through its Experiment station at General Villegas started in 2001 a program to advise farmers in the management practices more suitable according to the degree of wetness of their fields. However little is known on the consequences of management practices on a watershed scale in the long term.

Research questions being addressed:
- How affects a wet or dry year the actual evapotranspiration of eucalyptus;
- Will an increase in crop production levels raise water demands;
- What’s the effect of water plants covering the ponds and lakes;
- Is planting of reeds (or other species) effective to increase evaporation;
- Which will be an efficient design of a network of surface and groundwater monitoring points, under local constraints;
- Would it be possible to identify which roads may ensure a safer communication of flooded communities in the Encadenadas and Pergamino pilot areas.

Possible mitigation measures to consider are:
- Change in land use - use crops with a high evapotranspiration or forest (eucalyptus);
- Increase storage in ponds - to maintain high evaporation even when water level drops, it will increase effective storage and lowering of groundwater tables;
- Change in farming practice - how changes in crop rotation, production level, type of production systems and/or tillage practices may modify water demands;
- Applying high evaporating water plants in the farm ponds;
- Try to keep water in the higher parts (water retention in designated areas);
- Modification of surface water flow in the fields: in order to reduce outflows by more storage in the less productive lowlands (water retention in lowlands).

Highlights

Water consumption by eucalyptus:

The area just north of city of Rosario, belongs to the Carcarañá river basin in Cordoba Province and discharges into the Paraná river. The experimental plots with several Eucalyptus species are set up in a 4.200 ha plantation. On a yearly basis measurements of tree diameter and height are being performed in order to estimate wood production. Water budget components such as rainfall, groundwater levels and soil moisture down to 2 m depth are measured on four plots.
Estimates of the water budget are made with FAO Water Budget procedures. Surface and groundwater dynamics are assessed with the SIMGRO model, taking into consideration the soil, land use, relief and surface drainage network to a large detail.

Pehuajó pilot study:

In areas prone to flooding it is impossible to remove excess water by increasing drainage. Under such conditions a local solution deserves consideration. In this study the impact of afforestation is examined. To assess the sustainability of this intervention, climate change effects should be accounted for as well. A scenario study will be set up to quantify the effects of agroforestry and climate change. Two scenarios of increasing afforestation will be considered. The two climate change scenarios differ in how much warmer and wetter it will become in the near future. A representative area is being schematized using the hydrological model SIMGRO.

Further readings

Díaz, Raul and Erik Querner, 2005. Estimating the climate change effect upon flood risk reduction by afforestation. In: T. Wagener et al., Regional Hydrological Impacts of Climatic Change – Impact Assessment and Decision Making. Proc of Symp. 6, IAHS Scientific Ass. Foz de Iguaçu, Brazil, April 2005. IAHS Publ. 295: pp.249-253.

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Interesting links

INTA, Instituto Nacional de Technología Agropecuaria: www.inta.gov.ar
INTA, Instituto de Clima y Agua: www.intacya.org
INA, Instituto Nacional del Agua: www.ina.gov.ar