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An example of integration between en economic and an hydrologic model in the framework of water resource management problems

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Growing scarcity, increasing demand and bad management of water resources are causing weighty competition for water and consequently managers are facing more and more pressure in an attempt to satisfy users' requirement. In many regions agriculture is one of the most important users at river basin scale since it concentrates high volumes of water consumption during relatively short periods (irrigation season), with a significant economic, social and environmental impact. The interdisciplinary characteristics of related water resources problems require, as established in the Water Framework Directive 2000/60/EC, an integrated and participative approach to water management and assigns an essential role to economic analysis as a decision support tool. For this reason, a methodology is developed to analyse the economic and environmental implications of water resource management under different scenarios, with a focus on the agricultural sector. This research integrates both economic and hydrologic components in modelling, defining scenarios of water resource management with the goal of preventing critical situations, such as droughts. The model follows the Positive Mathematical Programming (PMP) approach, an innovative methodology successfully used for agricultural policy analysis in the last decade and also applied in several analyses regarding water use in agriculture. This approach has, among others, the very important capability of perfectly calibrating the baseline scenario using a very limited database. However one important disadvantage is its limited capacity to simulate activities non-observed during the reference period but which could be adopted if the scenario changed. To overcome this problem the classical methodology is extended in order to simulate a more realistic farmers' response to new agricultural policies or modified water availability. In this way an economic model has been developed to reproduce the farmers' behaviour within two irrigation districts in the Tiber High Valley. This economic model is then integrated with SIMBAT, an hydrologic model developed for the Tiber basin which allows to simulate the balance between the water volumes available at the Montedoglio dam and the water volumes required by the various irrigation users.
The results obtained by the integration of the economic component with the Simbat simulation can be used both for the planning phase, by evaluating the degree of the critical state of the different users belonging to the network and their hypothetical priorities, and for the management phase as a decision support system, especially for multi-year drought cycles. The policy maker would be then able to steer farmers' choices and could obtain a set of economic (gross income) and agronomic information (irrigated area, water consumption, monthly distribution of the annual available volume, etc) related to the optimal cropping pattern.