Measures, methodologies and tools for a sustainable agricultural management: Experience and preliminary results from Greek catchments

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Agriculture is by far the largest consumer of freshwater resources in Greece, accounting for nearly 90% of the total abstractions for irrigation purposes and at the same time the main responsible for setting water bodies at risk of not reaching targets set by environmental legislation due to high nutrient (Nitrogen (N) and Phosphorus (P)) concentrations. Water scarcity and drought, land desertification due to soil erosion and water shortages as well as sediment and nutrient water pollution are major environmental concerns in Greece, a country with typical geoclimatic conditions of the Mediterranean area with rough topography, erosive soils and uneven precipitation distribution with extreme rainfall and flush-flood events. These concerns become greater in areas where farming practices such as extensive irrigation, deep soil tillage, high chemical fertilization and manure application, high livestock stocking rates and over-grazing have been identified as potential pressures deteriorating the quantity and quality of water bodies. In order to address these pressures and reach a "good ecological status" of water bodies (ideally, although improbably, by 2015), it is essential that agricultural Best Management Practices (BMPs) be included in the Programs of Measures (PoMs) of the River Basin Management Plans (RBMPs). However, a key element of these plans is the cost-effective implementation of such practices at the river basin scale in order to meet the required multiple objectives related both to the good status of water and the maintenance of the high economic value of agricultural systems for farmers.

Working on this field of research, the authors have already developed and used novel tools and methodologies that promise to assist in the development of a sustainable agricultural management planning in Greek river basins, where there is urgent need for dealing with the problem of data scarcity in a consistent and efficient way, as well as for meeting the notable delays in the implementation of the environmental legislation. Distributed models have been developed for several basins, which have indicated the most suitable locations for BMPs implementation, based on comprehensive model validation approaches that face the problem of data limitations and provide a solid and reliable basis for testing the effectiveness of different measures. Great efforts have also been made to develop economic instruments for costing measures at the river basin scale, incorporating BMPs implementation cost and income reduction, thus enabling the calculation of the cost-effectiveness of measures and scenarios against multiple environmental objectives. Moreover, decision support systems have been developed by combining models, economic data and robust evolutionary algorithms in order to enable the identification of the most cost-effective BMP allocation schemes across the agricultural land of river basins. This study presents the most recent results produced from the implementation of these tools and methodologies in catchments of Central and Northwestern Greece and concludes that the combination of distributed physically-based models with socio-economic data, decision support tools and possibly with novel products of the satellite/remote sensing technology can be the next step in decision-making for quick and accurate environmental predictions and acceptable agricultural management solutions in river basins.