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Managing water scarcity in the Magdalena river basin in Colombia.An economic assessment

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In Colombia, serious water conflicts began to emerge with the economic development in the 70ies and 80ies and the term “water scarcity” became a common word in this tropical country. Despite a mean annual runoff of 1840 mm, which classifies Colombia as a water rich country, shortfalls in fresh water availability have become a frequent event in the last two decades. One reason for the manifestation of water scarcity is the long-held perception of invulnerable water abundance, which has delayed technical and political developments to use water more efficiently.

The Magdalena watershed is the most important and complex area in Colombia, because of its huge anthropogenic present, economic development and increasing environmental problems. This river basin has a total area of 273,459 km2, equivalent to 24% of the territory of the country. It is home to 79% of the country’s population (32.5 million of inhabitants) and approximately 85% of Gross Domestic Product of Colombia is generated in this area. Since the economic development of the 1970s and 1980s, large changes in land cover and related environmental conditions have occurred in the Magdalena basin. These changes include deforestation, agricultural land expansion, soil degradation, lower groundwater and increased water pollution.

To assess the consequences of geophysical alteration and economic development, we perform an integrated analysis of water demand, water supply, land use changes and possible water management strategies. The main objective of this study is to determine how global and local changes affect the balance between water supply and demand in the Magdalena river basin in Colombia, the consequences of different water pricing schemes, and the social benefits of public or private investments into various water management infrastructures.

To achieve this goal, a constrained welfare maximization model has been developed. The General Algebraic Modeling System based mathematical program uses information from spatially detailed Geographic Information System including topography, land cover and water systems. Spatially resolved economic data are included to depict price and income sensitive consumption decisions of major water users. Water management adaptation options include wet ponds and dams. The model maximizes economic net benefits subject to physical and technological constraints. The results of this study are relevant to water management stakeholders, and to governmental agencies for the development of better water policies.