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Economic Effects of Climate Change in the Middle Drâa Valley in Morocco

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Abstract

Irrigation water is essential for agriculture in the semi arid Drâa River basin in southeast Morocco. However, prolonged drought periods and effects of climate change will worsen the unreliable water supply situation in the future. Characterized by small palm tree oasis along the River Drâa, agriculture is mainly practised in form of subsistence farming through the cultivation of dates, cereals and fodder. Farmers have the choice of surface- and groundwater for irrigation, whereas the overuse of the later has lead to a decrease of groundwater tables and an increase of salinity rates during the last years. Implementing uncertainty in water resource management models has been an increasingly recognised tool to more realistically simulate river basin management. In this paper a hydro-economic river basin model is extended towards a stochastic modelling approach to incorporate the uncertainty of water supply. The model is an optimisation model which maximises agricultural net revenues over all oases under two main constraints: land and water. Both water quantity and water quality are considered for yield formation of seven major crops. On the basis of meteorological climate change scenarios from an interdisciplinary water research project, parameters of the water availability density function is calculated using maximum likelihood techniques. Based on these distributions, a random variable for water supply is introduced to simulate inflows into the system. Scenarios are simulated for one year with random reservoir inflows. Model results show that currently the probability of farmers to receive revenues below the existence minimum is around ten percent but this is likely to worsen in the future when water for irrigation becomes more scarce and unreliable depending on the assumptions of the climate change scenarios. Groundwater use for irrigation is increasing when surface water becomes scarce although groundwater is assumed to be more costly than surface water.

Keywords: Mathematical programming, Morocco, uncertainty, water resources

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