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Results from a Spatial Water Allocation and Choices of Technologies Model for Irrigation Systems — A Case Study on Watershed Management in Shaanxi, China

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Abstract

The issue of efficient water use has attracted much attention. For instance, China is facing severe water shortage due to geographical and demographic arguments. Especially under-developed water conservation technology and inefficient management are big problems for farmers and the government. Major questions at hand are how to improve water use efficiency, to optimize water allocation in agriculture, to invest in water saving technologies, and to assure water for high value added agriculture.

This paper investigates the impact on water use efficiency by taking into account individual farmers' adoption of modern water saving technologies and improvements of water transit, contributed by the public sector, from sources to end of canals. It shows results from a spatial water allocation model (SWAM) according to the approach of Umetsu. The main contribution of the study is to optimize the water allocation and choices of irrigation technology for farmers in a Chinese water project. Empirical data for the study was collected from a northwest Chinese county, Li Quan, Shaanxi Province in 2000, in which the farming system is dominated by apple production. Farmers ensure their food security by growing apples for food exchange. The SWAM model uses GAMS for optimization. The model contains an objective function of net benefits of a watershed subjects to several constraints. The most important constraints are equations of motion for canal water and groundwater which it takes into consideration simultaneously. The other constraints are farm water use efficiency as a function of private investment and canal water loss rate as a function of public investment in water transit, respectively. The SWAM model is a dynamic programming model, which is characterized by a variation of water use over the project area. By solving the SWAM model the net benefit in the watershed, the canal water consumption, the groundwater consumption, the investment in public canals, and the suitable technologies for farmers, as applied in different locations, are optimized. The model results are of great value for policy maker and project manager to allocate water efficiently, optimize irrigation projects, and provide references for farmers to apply suitable water conservation technologies.

Keywords: A spatial model, water use efficiency, water allocation, irrigation technology

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