IWRM2018-80
8th International Water Resources Management Conference of ICWRS

Irrigation and Crop Production under Climate Change and Influence on Energy Use and GHG Emission in Northeast China

Tingting Yan (1), Jinxia Wang (2), Jikun Huang (2), Wei Xie (2), and Tingju Zhu (3)

(1) Development Research Center of the Ministry of Water Resources, Beijing 100038, P.R. China, (2) China Center for Agricultural Policy, School of Advanced Agricultural Sciences, Peking University, Beijing 100871, P.R. China, (3) International Food Policy Research Institute, 2033 K St, NW, Washington, DC 20006, USA

The water-food-energy-GHG nexus under climate change has been gaining increasing attention from both the research and policy communities, especially over the past several years. However, most of those published literatures focused on the interdependence of food and biofuels, or water and hydro-power, or thermoelectric production and water security, or the energy consumption in water utilization, very few studies provide integrated analysis of this nexus across all the four sectors.

The overall goal of this study is to illuminate the water-food-energy-GHG nexus under climate change by assessing the effects of climate change on agricultural production through the change in water availability, evaluating the adjustment responses by farmers and resulted changes in energy use and GHG emission. The study area focuses on Northeast China, which is a major grain production region and highly dependent on irrigation with a limited water endowment. We first simulate the impacts of climate change on crop yield through its effects on the water availability without considering farmers' adaptive adjustments. Second, after considering farmers' autonomous adaptations to climate change driven by profit maximization (and risk minimization), we analyze changes in cropping pattern, irrigation intensity, crop yield and output, and profits. Third, the total water effects are decomposed to evaluate which adjustment measure is the dominant one given a reduced water supply. Finally, the energy use and GHG emission from irrigation are estimated at both the regional and the national levels.

Based on our simulation results, by 2030, climate change is projected to increase the gap between water supply and demand for irrigation in Northeast China. Due to the increase in water scarcity, irrigated areas will decrease, and the cropping pattern will be adjusted by increasing maize sown areas and decreasing rice sown areas. As a result, the total output of crops and profits will clearly be reduced. Based on the change in the irrigation water supply, energy use and GHG emission from irrigation will also be reduced.

The suggestions of this study are as follows: climate change impact assessment should fully consider the nexus among water, food and energy, otherwise the overall impacts of climate change will be underestimated; the adaptation measures adopted by farmers will reduce the risk of climate change for crop production, in which implementing irrigation measures (such as extending water-saving technologies), optimizing the cropping pattern (reducing the sown area of water-intensive crops) and improving water productivities (such as planting drought-resilient varieties) are highly recommended; while energy use and GHG emission are both estimated to decrease due to the reduction in irrigation water caused by climate change, the effects of other factors, such as the application of water-saving technologies, the limitations of pumping groundwater and the use of renewable energy sources for irrigation are the issues needed further studies.