



Water-food Nexus Management: The “Urgency of Now” in Arid Regions

Amin Elshorbagy (1,2) and Ahmed Abdelkader (1)

(1) Civil, Geological, and Environmental Engineering, University of Saskatchewan, Saskatoon, Canada

(amin.elshorbagy@usask.ca), (2) Global Institute for Water Security, University of Saskatchewan, Saskatoon, Canada

The water-food or water-energy-food nexus is an emerging theme within the geosciences and social sciences research communities. However, we argue that the accelerating water and food gaps, and the fact that they exacerbate each other in a vicious cycle, especially in arid regions, make the problem the “urgency of now”. Water resources availability and sustainability are critical components for economic development and growth. Globally, half of the land area of challenged economies in developing countries is in arid regions. Therefore, effective management of agricultural water use, which is the major water consumer, is a national priority. In this study, we identify cropping pattern planning as a major policy variable for agricultural water management in arid regions. We consider the case study of Egypt, as an example of a hyper-arid climate, to show case the inseparable nature of water and food security. A framework for the generation and assessment of alternative cropping pattern alternatives (ACPs), called ACPAR, is developed. The ACPAR framework is applied to the case study of Egypt, for which we already developed a simulation-based national water, food, and trade (NWFT) model. ACPAR is formulated to simultaneously minimize the national agricultural water demand, food (virtual water) imports, and the economic cost of imports as well as maximize the national gross margin of agriculture; these four objective functions are used to generate several non-dominated ACPs. Additional filtering criteria (intended to be an intervention tool by policy makers) are employed to account for fertilizer use as well as the inter-annual stability of the set objectives. The objective functions and the filtering criteria of the ACPs generated are evaluated using the NWFT model during the baseline period (1986-2013) as well as projected up to year 2050 under various combinations of national development and global food price scenarios. The results show that the ACPAR framework developed is useful for proposing ACPs that could have worked better for Egypt during the baseline period, and can be the basis for more sustainable future. The quantified tradeoffs between Egypt’s food self-sufficiency, the national water demand of agriculture, the gross margin in the agriculture sector, and the economic cost of imports are the key contributions of this study, representing important information for policy makers to aid in important decisions. The ACPAR framework connects the national water resource management decisions to the global food production, consumption, and trade dynamics. This study demonstrates that the nation’s water management is sectorially intertwined with other sectors (e.g., food or energy) and geographically linked to global dynamics.