Collaborative Research: Crops, Climate, Canals and the Cryosphere in Asia - Changing Water Resources around the Earth's Third Pole

This project is generating an integrated assessment of the impacts of climate-, and human-driven changes in hydrology on agricultural production and land use in Central, South, East, and Southeast Asia, and the implications for regional food security and economic welfare in the coming decades. It combines future climate projections, remote sensing and hydrological data together with hydrological, geophysical, agroecosystem and economic modeling to characterize the relative importance of local precipitation, runoff, groundwater mining, interbasin water transfers, and agricultural and non-agricultural water use for the region's water supply-demand balance. The project goal is to estimate how effects of climate change on high-elevation snow, ice, and permafrost hydrology will affect downstream water resources and food production, and through scenario analyses with regard to e.g. dam construction and other large-scale water engineering efforts.

The project is assessing current and projected water resources in the watersheds of the major rivers draining from the Asian High Mountains (principally the Indus, Ganges, Brahmaputra, Salween, Mekong, Yangtze, Yellow, Amu Darya, Syr Darya, and Irtysh Rivers), with a particular focus on the climatic change and variability impacts on runoff from the highlands. Irrigated agriculture is widespread in the study region, and water resources are tightly linked to food supplies. Agricultural economies support the majority of the regional population, so water and food resources are a key factor in the regional economy. This project is linking water supply and potential food production to an economic model, enabling assessment of water use, cropping intensity and yields in each of the various crop production sectors of the economy. The project is characterizing the response of downstream water demand and agricultural production to increased population, economic activity expansion and constrained water supplies, and assessing the implications of improvements in irrigation and crop water use efficiency, proposed major interbasin water transfer projects and dam construction, and deep groundwater depletion for food security and trade in the region's economies. Simulation uncertainties are assessed by sensitivity analyses driven by uncertainties in both model parameters and agricultural and hydrological databases. The project has collaborative ties with researchers in several countries in the study region, and they are contributing to efforts to obtain relevant data on regional land and water use.

Water and food security in Asia in the face of climate change and rising populations is an issue of global importance. Much of the study region is already experiencing physical or economic water scarcity, and major water engineering works are planned in both India and China. This broadly interdisciplinary project (geosciences, agricultural sciences, social sciences) is quantifying contemporary water resources, water use for agriculture, and food production, and the economic consequences of future climate change on water and food prices in the study region. Knowledge gained in this study will improve the capacity of integrated assessment modeling to account for the physical constraints of water resources on future economic and social activity, and mitigation and adaptation strategies. This project includes graduate student education & training and undergraduate research opportunities. In addition, the project is developing learning modules on global change in Asia, with a focus on water and food resources and sustainability, for an NSF-sponsored K-12 global change education outreach program. The project is contributing to stronger and deeper international collaborations with researchers in Asia. Finally, the project is contributing to the global change research community's capacity to integrate physical and social sciences, which is essential to address the broadly interdisciplinary issue of water, climate, and sustainability.