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PhD Project:

Hydro-economic modeling of socio-ecological systems: The case of the Lake Naivasha Basin in Kenya

Background

The world is facing severe and growing challenges in maintaining water quality and meeting the rapidly growing demand for water resources. The challenge is more severe for developing countries where water is becoming increasingly scarce due to globalized economy, population growth and climatic variability. Absences of appropriate institutions for efficient resource management worsen the problem; as a result water is available to users at no cost or heavily subsidized price. So, users have no incentives to conserve water and it is often overused or wasted instead of treated as scarce resource. This led to increased demand for institutional and policy reform for efficient allocation of water resources across users and sectors. However, suitability of these institutions and their likely effect on the resilience of water based socio-ecological systems (SES) to droughts and other temporary shocks is less studied. This study views the Lake Naivasha Basin in Kenya as hydro-economic system to quantify the resilience of water based SES using numerical simulation model. The basin's economy and the livelihood of its inhabitants are highly dependent on the resources water and land, both of which are becoming increasingly scare due to population growth and the boom in flower industry and other irrigated agriculture.

Research objectives and methodology

The objective of this study is to assess the resilience of Lake Naivasha Basin's SES in an integrated modeling approach by simulating the hydrological, agronomic and economic processes that are relevant for resilience assessment. The multi period simulation will be carried out using Hydro Economic Basin Model called LANA-HEBAMO. Conventional Hydro-economic River Basin Models (HERBM) are based on mathematical programming explicitly formulated as aggregate optimization problem that assumes central planning of land and water use, or the existence of perfectly functioning markets for water use rights. Both assumptions are not realistic in the case of the Naivasha Basin where neither central planning nor water trading exist. To enable policy analysis under the assumption of imperfect institution, we will use conceptually innovative solution format for HRBMs, based on Multiple Optimization problems with Equilibrium Constraints (MOPEC), developed by Britz et al. (2013)[1] . The model requires extensive data input from hydrology, agronomy, demography and Economics. For hydrology we will use secondary data from ITC Enschede, the Netherlands and for demographic census we will use data from Kenya National Bureau of Statistics. Additional survey will be conducted to collect Agronomic and Economic data.

[1] http://www.sciencedirect.com/science/article/pii/S136481521300073X