Agent-based Simulation of Human-environment Interactions in Small Wetlands in Kenya and Tanzania

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Abstract

Large numbers of small wetlands in Kenya and Tanzania are currently drained for agricultural and horticultural production purposes. Socio-economic changes, biophysical and policy-related factors are the main driving forces. Understanding and quantifying complex interactions for scenario analyses requires the application of integrated research approaches. Agent-Based Models (ABMs) have been recognised as useful tools for representing human-environment systems. Numerous studies have shown that ABMs are capable of simulating the mutual relations between humans and their environments in mechanistic and spatially explicit ways. Building credible ABMs to provide guidelines and tools for wetlands planners and decision makers requires empirical analyses of agent's behaviours as well as rigorous analyses of wetland use dynamics and farmer's decision-making processes plus identification of main drivers which influence these decisions.

Prior to the application of an ABM for characterising integrated scenarios of wetland use in East-Africa we conducted intensive households and field surveys to characterise household agents' behaviours. Individual interviews combined with village wetland farmers' group discussions were used to capture livelihood typology of households based on human, social, financial, natural and physical capital. Additional data was collected on wetland historical use, and the main drivers for wetland use as well as conflicts occurring between agents who compete for wetland resources. Data of spatially explicit land uses and management practices as well as cropping systems and outputs were gathered at the farm level from household interviews.

Rural farming communities have diverse livelihoods which are reflected in complex attitudes towards wetland use. They have created high pressures on wetland resources for maintaining their livelihoods. Multivariate analyses techniques are applied for classifying wetland types and to define and characterise the different household livelihood typologies as well as socio-ecological determinants of their wetland use choices. In addition, multi-nominal logistic regression methods are used for identifying key determinants of wetland land-use choices by each agent groups based on plot-based datasets. Effects of wetland contributions to the livelihoods and consequences for land degradation were quantified in a screening study. We chose the Repast simulation toolkit which interfaces both with Java and ArcMap. First results of this study will be presented.

Keywords: Agent-based modelling, agricultural use, decision-making, human-environment interactions, Kenya, small wetlands, Tanzania

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