



Tropentag, October 9-11, 2007, Witzenhausen

“Utilisation of diversity in land use systems:
Sustainable and organic approaches to meet human needs”

Landuse Changes, Mangrove Destruction, and Vulnerability in Maduganga Lagoon, Sri Lanka - Empirical Analyses Towards Agent-Based Modelling

MARCUS KAPLAN¹, QUANG BAO LE², FABRICE RENAUD¹

¹*United Nations University, Institute for Environment and Human Security, Germany*

²*University of Bonn, Department of Ecology and Natural Resource Management, Center for Development Research (ZEF), Germany*

Abstract

The study investigates landuse and land-cover changes (LUCC) in Maduganga Lagoon on the south-western coast of Sri Lanka. LUCC are caused by a set of interacting driving forces, which are formed by a complex of biophysical, socio-economic, political, technological, and cultural variables. Therefore, understanding of historical LUCC as well as the simulation of future developments calls for integrated approaches. Agent-Based Models (ABMs) have been recognised as an appropriate means for integrated landuse analysis, since they provide a natural presentation of the human-environment systems and capture related biocomplexities. However, building creditable ABMs to inform land management requires empirical analyses of agent behaviour as well as rigorous characterisation of historical landuse dynamics.

Prior to the application of an ABM for depicting integrated scenarios of LUCC, we conducted intensive field surveys and empirical analyses to characterise household behaviour and historical LUCC. Interviews with 538 households living around the lagoon were done using a structured questionnaire that captures the five asset categories of the Sustainable Livelihoods framework. Plots of all interviewed households were visited to gather spatially explicit landuse practices and outputs. Multivariate statistics was used to define and characterise the different household livelihood typologies, and socio-ecological determinants of their landuse choices. In addition to the agent parameterisation for the ABM, the analyses also show empirical effects of environmental degradation and the destruction of mangroves on the livelihood of the people and their vulnerability to different types of hazards, particularly considering the tsunami in 2004.

Historical LUCC are analysed using aerial photographs and Landsat ETM+ imagery. The spatial analysis detected increases in agricultural lands and urban structures during the last 50 years at the expense of mangroves and other forest ecosystems.

Since our empirical analyses are household- and spatially-explicit, we will use the data and analytical results for agent-based simulations of LUCC and associated socio-economic dynamics. These simulations will be derived from different scenarios of coastal landuse planning and forest protection. An existing ABM developed at the Center for Development Research (ZEF) will be modified in order to be applicable to our study area.

Keywords: Agent-based modelling, landuse modelling, mangroves, Sri Lanka, tsunami, vulnerability