Tropentag, October 6-8, 2009, Hamburg

"Biophysical and Socio-economic Frame Conditions
for the Sustainable Management
of Natural Resources"

Simulating Consequences of Land Use Change on Hydrological Landscape Functions and Sustainability of Crop Production in Northwest Viet Nam

Yohannes Ayanu[1], Carsten Marohn[1], N.V. Dung[2], N.T. Lam[2], Tran Duc Vien[2], Georg Cadisch[1]

[1] *University of Hohenheim, Institute for Plant Production and Agroecology in the Tropics and Subtropics, Germany*

[2] *Hanoi University of Agriculture, Center for Agricultural Research and Ecological Studies (CARES), Viet Nam*

Abstract

The Northern Mountaineous Region (NMR) of Viet Nam has undergone rapid land use changes in the past that shifted the traditional swiddening farming system to less sustainable continuous annual monocropping systems. This study aimed at assessing effects of rapid expansion of maize and rubber (*Hevea brasiliensis*) plantations in Tat hamlet watershed, Hoa Binh province, North Viet Nam, as response to increasing market demand. Effects of land use change on crop production and water balance were assessed over a 20 years simulation period using the Land Use Change Impact Assessment (LUCIA) tool, a spatially explicit dynamic watershed-crop model based on the PCRaster platform. The model was parameterised using four years of field data from the traditional swidden shifting cultivation system, collected by the Centre for Agricultural Research and Ecological Studies (CARES) from the study area and calibrated for crop yields and watershed functions using one out of the four year dataset. The results were validated against the remaining datasets (3 years) to verify model plausibility. Impact of land use intensification was investigatied using four possible model scenarios. The first and second scenario considered agricultural intensification as expansion of maize with / without application of fertiliser, respectively. Upland forests were assumed to be largely converted to maize lands under these scenarios. The third and fourth scenario dealt with introduction of rubber plantations in the uplands by converting forest lands, with / without undergrowth to mitigate surface run-off. Runoff, stream flow and plant available water were assessed as components of the water balance. Total biomass production per hectare was simulated for the vegetation in the area. Agronomic yield per hectare for each crop type was also calculated for consecutive years to evaluate changes over time. Each of these parameters was simulated at test points along Local Drain Direction and at the watershed outlet. The interlinkage between uplands and lowlands was assessed based on the impact of land use change on crop production and the aforementioned hydrological functions. The findings under each of the scenarios were compared with the baseline situation and recommendations were made for sustainable management of essential watershed functions in the area.

Keywords: Crop production, landscape modelling, landuse change, rubber, water balance

Contact Address: Carsten Marohn, University of Hohenheim, Institute for Plant Production and Agroecology in the Tropics and Subtropics, Stuttgart, Germany, e-mail: marohn@uni-hohenheim.de