Tropentag, September 20-22, 2017, Bonn

"Future Agriculture:
Socio-ecological transitions and bio-cultural shifts"

Assessing Impacts of Long-Term Maize-Cultivation Using the "Dynamic of Total Carbon and Nitrogen DistributionModel

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Abstract

Ongoing population growth spurred the demand of agricultural land further accompanied by agricultural intensification in Northwest Vietnam. This trend led to an expansion of mono-maize cultivation areas to steep sloping environments with the result of severe soil degradation. Against this background, the presented study evaluated the development of soil fertility under mono-cropped maize cultivation in Northwest Vietnam to offer decision support for natural resource management at watershed level. The specific objectives were: (1) determining the dynamics of total Nitrogen (NTot) and Carbon (CTot) under current maize cultivation regimes along selected transect gradients, and (2) developing the spatially-explicit Dynamic of total Carbon and Nitrogen Distribution (DyCNDis) model to assess potential impacts of CTot and NTot development after long-term and intensified maize cultivation patterns using Chieng Khoi watershed as an example.

Three transects were delineated to assess NTot and CTot content in topsoil along a 25–30 m slope gradient, and to determine crop history focusing particularly on the duration of maize cultivation period. Building on transect results and further auxiliary data, the spatially-explicit DyCNDis model tool was developed using the relationship of cultivation time and C/NTot content as basic modelling unit. After successful model validation, DyCNDis was used for a soil degradation hotspot analysis, aiming to identify those areas at watershed-level which have the highest risk of soil degradation under the current mono-cropped maize cultivation regime.

DyCNDis identified 134 ha of hotspot areas that are prone to soil degradation after 20 years of continuous maize mono-cultivation, accounting to 19 % of the total 708 ha of upland cultivation areas in Chieng Khoi watershed. DyCNDis suggested that particularly those areas require increased attention by government authorities and local farmers, calling for soil conservation measures to retain soil fertility in the long run.

Keywords: Carbon, long-term maize, model, Nitrogen

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