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"Utilisation of diversity in land use systems:
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Development of a Simple PCRaster-Based Model for Rainfall-Runoff Assessment in the Northern Mountainous Region of Viet Nam

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Abstract

Land degradation is a severe problem worldwide, particularly in resource-poor regions of the tropics when non-adapted cropping systems are used. One of these systems is slash and burn agriculture, involving clearing of land for cultivation which has to be fallowed after a short cropping period for three years or more to recover its soil fertility. When population densities increase and the availability of forest areas decreases or the extension in such areas is prohibited, arable land becomes a scarce resource, forcing farmers to prolong their cropping cycles and shorten the fallow periods. This leads to a severe, often irreversible decrease in soil fertility. Furthermore, it can lead to severe soil erosion on hillsides, particularly when associated with deep ploughing. Many studies have been undertaken to identify sustainable land-use options. In contrast to plot level, our understanding of the underlying processes of soil degradation at landscape level, which are often very complex, is limited. A modelling approach may, therefore, help to better understand the impact of new technologies or land-use intensification on land-use and environmental services. The objectives of this study were **(i)** to develop a simple spatially explicit rainfall and runoff model and **(ii)** to test its applicability for mountainous regions in Northwest Viet Nam. The model structure is presented, based on an approach developed by Karssenberg et al. (1997). It is written in PCRaster, a computer language for construction of iterative spatio-temporal environmental models. The model calculates the runoff which flows down the drain direction of the slope, depending on rainfall and soil cover. Data from the Ban Tat hamlet, located in the Da Bac district of the Hoah Binh province in North Viet Nam were used for model parameterisation and calibration. Model runs based on three scenarios were used to discuss the importance of influencing factors such as vegetation cover, vegetation cycle, and spatial distribution of land-use. Results showed that a long but less dense vegetation cover is more effective to prevent runoff than a dense but short vegetation cover. Furthermore, a row of forest between the cultivated fields significantly reduced runoff amounts, indicating the importance of soil conservation measures.

Keywords: Modelling, PCRaster, rainfall, runoff, swidden agriculture, vegetation cover, Viet Nam

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