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Assessing Hydrological Ecosystem Services under Land Use and Climate Change Scenarios in a Mountainous Watershed

Kevin Thellmann, Reza Golbon, Marc Cotter, Georg Cadisch, Folkard Asch

University of Hohenheim, Inst. of Agric. Sci. in the Tropics (Hans-Ruthenberg-Institute), Germany

Abstract

The extension of large-scale cash crop cultivation in Montane Mainland South-East Asia brought new livelihood options for farmers, who previously kept the century-long tradition of swidden farming. This change in land use transformed entire landscapes and thereby potentially altered critical biophysical structures and processes. These serve as the basis for the provisioning of ecosystem services (ESS) such as fresh water supply or the prevention of erosion. How resilient these altered landscapes are with regard to preserving hydrological ESS in the face of a changing climate is yet to be understood. We chose the Nabanhe Reserve in Xishuangbanna prefecture (Yunnan province, PR China) as a study area, as it saw an extensive expansion of rubber plantations within the past decades. The aim of this study was to assess the effect of rubber-related land use changes under multiple scenarios of climate change. We developed three land use scenarios in cooperation with local stakeholders for the year 2040. These include a Business-As-Usual scenario, where past rubber expansion rates will be continued in a linear manner, the 5-Year-Plan scenario, which is based on regional policy plans, and the Balanced-Trade-Offs scenario, which incorporates conservation measures such as riverine buffer strips and water protection zones. The resulting land use maps were used in combination with spatially explicit precipitation data based on two Representative Concentration Pathways (RCP 4.5 & RCP 8.5) of the Fifth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC5). Both represent main inputs to model sediment export and water yield on watershed scale with the InVEST (Intergrated Valuation of Ecosystem Services and Trade-offs) software suite. The methodology applied here can easily be adapted to other regions, as InVEST and the IPCC5 data are either open-source or freely available. The results provide valuable information to develop mitigation strategies in order to buffer adverse effects on hydrological ESS resulting from long-term changes in precipitation patterns.

Keywords: Climate change, ecosystem services, InVEST, land use change, rubber, scenario modelling

Contact Address: Kevin Thellmann, University of Hohenheim, Inst. of Agric. Sci. in the Tropics (Hans-Ruthenberg-Institute), Garbenstr. 13, 70599 Stuttgart, Germany, e-mail: kevin.thellmann@uni-hohenheim.de