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Abstract

In the upper catchments of Southeast Asia, land use change from forest to agricultural systems generated land degradation and conflicts between uplanders and lowlanders. More sustainable cropping systems are proposed to upper-catchment farmers. Grass fodder strip (GFS) is an effective anti-erosion practice, and it involves lower costs for farmers. However, labour and cash constraints are sometimes preventing farmers to implement it. To evaluate farms' current impact and adaptation capacities, we need a comprehensive understanding of farm and farm household characteristics that influence their activities. This paper proposes an approach that combines farm household surveys and modelling of farm erosion yield to help project planners and policy makers to identify such farmers in a data-scarce environment. We developed two farm typologies—one based on both farm and farm household characteristics and one based on their erosion yield and constraints. We calculated erosion yields on plot level by using revised universal soil loss equation method and identified their constraints. We found that a typology based on farm constraints and calculated farm erosion was a good complement to identify farmers who are generating the highest erosion yields and would be able to

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UPLAND FARMING SYSTEM EROSION YIELDS AND THEIR CONSTRAINTS TO CHANGE FOR SUSTAINABLE AGRICULTURAL CONSERVATION PRACTICES: A CASE STUDY OF LAND USE AND LAND COVER (LULC) CHANGE IN INDONESIA

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ABSTRACT

In the upper catchments of Southeast Asia, land use change from forest to agricultural systems generated land degradation and conflicts between uplanders and lowlanders. More sustainable cropping systems are proposed to upper-catchment farmers. Grass fodder strip (GFS) is an effective anti-erosion practice, and it involves lower costs for farmers. However, labour and cash constraints are sometimes preventing farmers to implement it. To evaluate farms' current impact and adaptation capacities, we need a comprehensive understanding of farm and farm household characteristics that influence their activities. This paper proposes an approach that combines farm household surveys and modelling of farm erosion yield to help project planners and policy makers to identify such farmers in a data-scarce environment. We developed two farm typologies—one based on both farm and farm household characteristics and one based on their erosion yield and constraints. We calculated erosion yields on plot level by using revised universal soil loss equation method and identified their constraints. We found that a typology based on farm constraints and calculated farm erosion was a good complement to identify farmers who are generating the highest erosion yields and would be able to change their production systems. This methodology is mainly useful at the beginning of conservation projects, when very few hard data are available. Copyright © 2016 John Wiley & Sons, Ltd.

KEY WORDS: LULC change; RUSLE; erosion; farm typology; constraints

INTRODUCTION

Land use and land cover changes from forest to agriculture tend to cause land degradation (Cerdà & Doerr, 2007; Choudhury *et al.*, 2015; Birka *et al.*, 2011; Rasul & Thap, 2003). In many cases, deforestation in upper parts of the watersheds not only caused decreasing soil fertility (Saha *et al.*, 2014; Novara *et al.*, 2011; Parras-Alcántara *et al.*, 2015; Mohawesh *et al.*, 2015; Wasak & Drewnik, 2015) but also modified hydrological flows and increased soil erosion which had consequences in downstream areas (Bruijnzeel, 2004; Keesstra, 2007).These modifications are increasing the number of conflicts between upstream and downstream populations (Thanapakpawin *et al.*, 2007). This is particularly the case in Indonesia, where high-value industrial crops, for example, tobacco, coffee, and vegetables, are often grown in upstream of catchments (Grainger *et al.*, 2003).

To make these agricultural systems more sustainable and less erosive, some changes are proposed to upper-catchment farmers. These include terracing, soil strengthening (grass strip and intercropping), or reverting back agricultural land to forest land (Okoba & de-Graaff, 2005; Muñoz-Rojas *et al.*, 2015). These changes, except terracing, would rely on vegetation cover to protect soils and reduce erosion significantly. Vegetation can cover soil surface and reduce rainfall erosivity (Keesstra *et al.*, 2016; Cerdà *et al.*, 2016). It can act as a slope breaker and reduce the slope factor (Cerdà, 1998), and it can trap sediments (Bochet, 2015; Novara *et al.*, 2013). Although literature shows that these changes may be economically attractive in the medium term, farming households could face initial revenue losses or constraints, preventing them to change. These constraints include extra labour requirements, extra out-of-pocket cash requirements (Affholder *et al.*, 2010; Ellis-Jones & Tengberg, 2000), and water constraints (Santosa & Sutikno, 2006; Ouedraogo *et al.*, 2015).

Moreover, as farming systems in the upper parts of the catchments are quite diverse, some farming systems may produce more externalities than others (Debolini *et al.*, 2013). In such case, targeting of specific farming systems, ideally those currently creating many negative externalities but able to change due to low constraints, would make future project or policy setting more effective and efficient. To evaluate farms' current impact and adaptation capacities, we need a comprehensive understanding of farm characteristics that influence their activities.

Therefore, the objective of this paper was to develop a methodology in a data-scarce environment to characterize

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