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Key socio-economic factors influencing sustainable land management investments in the West Usambara Highlands, Tanzania

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ABSTRACT

Low investments in sustainable land management (SLM) limit agricultural production in the East African Highlands, leading to increased soil erosion, low productivity of land and food insecurity. Recent studies in the region show that different socio-economic factors influence SLM investments by farmers, but knowledge on which of these are most influential and how to foster SLM is often lacking. This research fills this gap for the West Usambara Highlands, and determines key socio-economic factors influencing investments in SLM. Data for this research was collected from 196 randomly selected farm households in the Lushoto district, and Factor Analysis was used to reveal patterns of correlation between SLM investments and different household characteristics. Among the eight socioeconomic factors generated by Factor Analysis, four key factors were found to significantly influence SLM investments in upland (mainly rain-fed) agricultural fields: (1) the farmer's access to support services; (2) the farmer's experience with collaborative land management; (3) the household's income from crop sales; and (4) the farmer's forward driven attitude. The study concludes that a strategy to foster and scale-up SLM in the West Usambara Highlands should therefore improve the access of farmers to support services (especially micro-credits), trigger collaborative efforts in land management (e.g., farmer-to-farmer training) and promote investments in the rural area to create an enabling environment for SLM. A more active role of the Government, together with public and private sector partners, is therefore crucial.

1. Introduction

Low investments in sustainable land management (SLM) are a major concern in the East African Highlands (Stroud, 2003). SLM investments are defined as all efforts in the form of labor and (financial) inputs that farmers use to execute SLM practices, covering both short-term (annual) practices and practices aiming at long-term impact (Kessler, 2006). SLM technologies are particularly required in upland fields, where rain-fed agriculture on steep hillsides often causes soil erosion by water. Soil erosion is one of the main underlying causes of food insecurity in Tanzania, and strongly linked to low soil productivity (TNSGRP, 2005). SLM investments in rain-fed agriculture in these highlands are thus an essential component for food security (Tenge, 2005).

This study focuses on the West Usambara Highlands of Tanzania, an area where knowledge about SLM measures is widely available, but where only few farm households invest in SLM (Tenge, 2005). Little is known about what is limiting these farmers to invest in SLM, and which lessons to include in a strategy to promote spreading of SLM investments. This study fills this gap, and was conducted with the objective to determine key socio-economic factors influencing farm households to invest in SLM on upland rain-fed fields, and as such generate lessons for a participatory strategy to spread SLM in the West Usambara Highlands.

Studies conducted in different parts of the world have shown that a wide range of socio-economic factors influences farmers' investments in land management. These factors include personal characteristics, availability of resources (also financial), participation in past programs, market conditions, access to markets, and extension strategies (Adimassu et al., 2012; Bamlaku, 2011; Kessler, 2006; Paudel and Thapa, 2004; Tenge at al., 2004). Farm household related characteristics are found to be particularly important; e.g., education level of the head of a household strongly influenced land conservation in Nepal (Paudel and Thapa, 2004). In Ethiopia it was

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a combination of factors (resource endowment, farm household experiences, knowledge and access to information) that explained farm household's decisions on how much and where to invest in land management (Adimassu et al., 2012). Progressiveness and economic stratum of a farmer were two key factors influencing the decision on how much to invest in soil and water conservation in Bolivia. Market oriented farmers invested more than others (Kessler, 2006). Specifically in the West Usambara Highlands availability of labor was found to influence farm household land conservation efforts (Tenge et al., 2004). Often researchers find a close relationship between income, SLM investments and market orientation. Access to market positively and significantly influenced SLM investments in Ethiopia (Bamlaku, 2011). Good market access was also one of the factors that contributed to conservation efforts in the Machakos region of Kenya (Zaal and Oostendorp, 2002). Hence, a good and reliable market is an incentive for farmers to invest in SLM. There is also often a positive correlation between income and investments in technologies (Sulo et al., 2012). Different sources of cash are used to finance SLM investments, and remittances from family members working off-farm financed SLM investments in Kenya (Pagiola, 1994). In the West Usambara Highlands unavailability of credit was found to reduce land management investments (Tenge, 2005).

However, not only the above mentioned specific factors influence SLM investments, but also lack of effective operational strategies to trigger knowledge and information sharing was reported to limit the spread of SLM (Kessler, 2007). It can therefore be concluded that farm households' SLM investments are influenced by technical, physical, socio-economic, cultural and institutional factors, but the actual influence of these factors differs in space and time. Also the extent of influence differs among these factors. This paper looks into these factors for the specific case of the West Usambara Highlands, with SLM investments understood as investments made by farmers to maintain or improve soil productivity of their upland agricultural fields.

2. Research methodology

2.1. Description of the study area

Lushoto District forms part of the West Usambara Highlands and is located in the fragile East African Highlands (Fig. 1). The district is the most densely populated in the Tanga Region, hence the demand for land and the need for SLM is high. The population of Lushoto district has almost tripled between 1957 and 2002, from about 150,000 to 423,000 inhabitants. The district has an average household size of 5 persons. The population density is estimated at 200 people/km^2 (Mowo et al., 2002).

Agriculture is the main economic activity for 87 percent of the total population (NBS, 2012). Mixed farming systems are most common, with farmers generally involved in upland (mostly rain-fed) agriculture, traditionally irrigated fields in the valley bottoms, livestock keeping and off-farm activities (Tenge, 2005). The district can be subdivided into four agro-ecological zones, and the main soil types found are Acrisols, Phaeozenis, Nitisols and Luvisols. The altitude varies from 600 to 2300 meters above sea level. The district has a bimodal rainfall pattern: long rains start in March and last till May, while short rains are from November to December. Major ethnic groups are Sambaa (78%), Pare (14%) and Mbugu (5%).

The study was carried out in two selected research villages (Shashui and Sunga) located in two different agro-ecological zones: E2 and E12 respectively (De Pauw, 1984). Both villages receive similar amounts of rainfall of 800–1000 mm/year, but zone E2 (Shashui) is slightly warmer and situated at a lower altitude (800–1800 masl) than zone E12 (Sunga at 1200–2000 masl). The topography in both villages is mountainous, but the landscape of Shashui is more dissected (steeper slopes, see Fig. 1) than around Sunga (Wickama et al., 2014).

Concerning SLM in both villages, a recent study by Wickama et al. (2015) found that in Sunga almost 20% of the agricultural land is covered with bench terraces and grass strips, whereas in Shashui this is only 2.6%. This higher percentage in Sunga is attributed to the efforts over the past 20 years of previous projects in this area.

2.2. Data collection

A combination of methods was used for data collection. Both qualitative data (e.g., opinion about prices of inputs) and quantitative data (e.g., farm size) were collected. Primary data collection was carried out by means of semi-structured household questionnaires, interviews with key informants and observations. Secondary data were collected through literature review from different sources. A total of 196 farm households (41 headed by women) from Shashui and Sunga villages were interviewed.

An inventory in the villages revealed the following main SLM technologies: bench terraces, *fanya juu,* grass strips, cut-off drains, infiltration ditches, micro-contour lines, agroforestry and mulching. These technologies reduce soil erosion, retain moisture and nutrients and have a positive effect on crop yields (Tenge et al., 2005). Farm households were divided into five SLM investment categories (ranging from 1 = no investments to 5 = major investments), based on an inventory of the actual SLM investments in upland fields, considering three major aspects: (1) type of technologies; (2) maintenance of SLM technologies; and (3) use of inputs such as farm yard manure, improved seeds and fertilizers.

Based on literature review and interviews, 52 household characteristics were listed that potentially influence SLM investments. From this list, and after Spearman correlation analysis, 31 variables (Table 1) were selected for further analysis. Each remaining variable (except "membership in labor groups", "gender of household head" and "attendance to training" because of being dichotomous) was categorized on a scale of 1–5 to allow for statistical analysis (correlation with SLM investments in upland fields). For example: the variable access to credits was categorized 1 if the farmer had readily available access to credits, and 5 for having "no access to credits". Similarly, "importance of farming" covered aspects like acreage, income and time spent, and was ranked between 1 (very important) to 5 (not important).

2.3. Data analysis

Exploratory Factor Analysis (FA) was employed on the 31 variables to identify major socio-economic factors resulting from the rotated FA matrix. The number of factors retained for rotation was determined by the Keizer criteria. Two criteria were used to retain a variable: (i) those with an Eigenvalue of 1 or greater and (ii) those with a loading value greater than 0.4 (Field, 2009). Based on these criteria 9 out of 31 variables were dropped due to low loading values. Among the dropped variables was "family labour" due to a loading lower than 0.4. Previous studies conducted in the area found that family labour had an important influence on adoption of SLM practices (Mbaga-Semgalawe and Folmer, 2000; Tenge et al., 2004). The reason for its low loading in the current study could be that availability of labor through labor sharing groups is now more important; this is accounted for in the variable "membership of labor-sharing groups".

To avoid multi-collinearity and obtain the simplest possible pattern (maximization of variance of the squared loadings in each column of the factor matrix), orthogonal rotation using the varimax procedure was utilized to extract the major socio-economic factors. Following, factor scores were calculated for each of the