Research Application Summary

Determinants of adoption of soil erosion control technologies in Mt. Elgon highlands in eastern Uganda

Barungi, M.[1], Ng'ong'ola, D.H., Edriss, A.[1], Mugisha, J.[2], Waithaka, M. & Tukahirwa, J.
[1]Department of Agricultural and Applied Economics, Faculty of Development Studies, Bunda College of Agriculture, University of Malawi
[2]Department of Agribusiness and Natural Resource Economics, College of Agricultural and Environmental Sciences, School of Forestry, Environmental and Geographical Sciences, Makerere University, P. O. Box 7062, Kampala, Uganda
[3]Association for Strengthening Agricultural Research in Eastern and Central Africa (ASARECA)
[4]African Highlands Initiative (AHI)
Corresponding author: mildredbarungi@yahoo.com; mbarungi@eprc.or.ug

Abstract

The study made an inquiry into the determinants of adoption of soil erosion control technologies in Bukwo and Kween districts. We found adoption would be high if farmers own different types of farm tools, get frequent extension advice, are close to output markets, own many hectares of land, and have higher income. Some of the recommendations based on the findings are expansion of coverage of relevant extension services and support to farmers to enable them increase their incomes so that they can afford to acquire the different types of tools used in application of soil erosion control technologies.

Key words: Adoption, Bukwo, Kween, soil erosion control

Résumé

L'étude a fait une enquête sur les déterminants de l'adoption des technologies de lutte contre l'érosion dans les districts de Bukwo et de Kween. Nous avons trouvé que l'adoption serait élevée si les agriculteurs possèdent les différents types d'outils agricoles, obtiennent des conseils d'extension fréquents, sont proches des marchés de produits, possèdent beaucoup d'hectares de terres, et ont un revenu plus élevé. Certaines recommandations fondées sur les conclusions sont l'expansion de la couverture des services pertinents de vulgarisation et le soutien aux agriculteurs pour leur permettre d'augmenter leurs revenus afin qu'ils puissent se permettre d'acquérir les différents types d'outils utilisés dans l'application des technologies de lutte contre l'érosion.

Mots clés: Adoption, Bukwo, Kween, lutte contre l'érosion des sols

Background

In Uganda, agriculture is the core sector for economic growth, food security, income enhancement, and employment. Although the sector's share in total GDP has declined from over 50% in the early 1990s to only 13.9% in 2010/11, agriculture socially remains the most important sector because most Ugandans derive their livelihood from it. In 2009/10, the sector employed 66% of the working population (UBOS, 2010). Further, the 2005/06 Uganda National Household Survey estimated that there were 4.2 million agricultural households, constituting 78.8% of all households in the country (UBOS, 2007). Despite the role played by the agriculture sector in Uganda's economy, land degradation is a big problem country wide. However, the worst affected areas are highlands (Olson and Berry, 2003), which account for 27% of land area and accommodate close to 40% of the total population. According to a report by the National Environmental Management Authority of Uganda, about 85% of the land degradation is accounted for by soil erosion and nutrient depletion (NEMA, 2001). Signs of land degradation impacts are evident and at household level they include declining crop yields. At national level, the country was estimated to lose 4% to 12% of total Gross Domestic Product because of land degradation (Slade and Weitz, 1991). In an attempt to overcome the impacts of land degradation, soil and water erosion control technologies have been promoted among farmers in the affected areas. Research evidence has shown that farmers in the highlands of eastern Africa can increase their farm productivity by up to five times upon adoption of soil erosion control technologies (Mowo *et al.*, 2002). However, land degradation interventions in Uganda have achieved minimal impact because of low adoption, which is mainly attributed to the gap between knowledge and action (Mowo *et al.*, 2008) but is exacerbated by factors such as lack of enabling policies and appropriate institutional arrangements that give incentives for adoption of soil erosion control technologies. A review of previous studies indicates that the constraints and catalysts to wide-scale adoption of soil erosion control technologies have not been clearly documented. Findings from this study generated information that can be applied by the Government of Uganda and other partners in development of the agriculture sector to increase the use of soil erosion control technologies and thus minimise impacts of land degradation.

Objectives

The underlying objective is to generate knowledge and information needed to scale-up and out adoption of soil and water erosion control technologies in areas affected by land

degradation. Specifically, the study aims to; (1). Measure the incidence and intensity of adoption of soil erosion control technologies, and (2). Establish the factors that affect the incidence and intensity of adoption of soil erosion control technologies.

Methodology

The study was conducted in Mt. Elgon highlands, which account for 50% of the land degradation in Eastern Uganda. The study was specifically undertaken only in Kween and Bukwo districts, where highlands cover about 37% of the total land area. Farmers in this zone experience severe land degradation due to the steep rugged nature of the terrain, the problem is aggravated by heavy rains (Nkonya *et al.*, 2008). The two major forms of land degradation in the zone are soil erosion and nutrient depletion (MFPED, 2000).

A multi-stage (six stages) sampling procedure involving a combination of purposeful and random sampling procedures was used to draw a sample of 240 farmers. Primary data were collected from farmers using a semi-structured questionnaire and through face-to-face interviews.

The double-hurdle model was used to analyse the determinants of both incidence and intensity of adoption of soil erosion control technologies. This model assumes that farmers make two sequential decisions with regard to adopting soil erosion control technologies. Each hurdle is conditioned by the farmer's socio-economic characteristics and technology-specific attributes. In estimating the double-hurdle model, a probit regression (using all observations) is followed by a truncated regression on the non-zero observations (Cragg, 1971).

Results

Overall, about 91% of farmers have adopted at least one soil erosion control technology. Contours (57% adopters) were the most adopted soil erosion control structures, followed by Napier grass (47% adopters) and agroforestry trees (43% adopters). On average, each adopter was using soil and water erosion control technologies on about 63% of the total farmland.

Important factors that positively affect the farmer's decision to adopt contours are; owning many different types of farm tools; and farmer's perception that his/her soil is fertile (reference category – soil is infertile). The only important factor that is likely to reduce the probability of adopting contours is undertaking farming as the main economic activity.

Table 1. Relative importance of different factors for adoption of soil erosion control technologies.

	Marginal effects and robust standard errors (in parenthesis)				
	Contours	Terraces	Napier grass	Trees	Trenches
Number of adults in a household	-0.001(0.020)	-0.025 (0.018)	0.027 (0.024)	-0.030 (0.022)	-0.020 (0.021)
Estimated average income earned annually	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)	0.000 (0.000)**	0.000 (0.000)
Age (years)	-0.001(0.003)	0.000 (0.003)	0.002 (0.003)	0.004 (0.003)	0.004 (0.003)
Sex (1= Male, 0 = Female)	-0.034 (0.092)	0.281(0.048)***	-0.186 (0.094)**	-0.097 (0.089)	-0.213 (0.093)**
Years of formal schooling	0.000 (0.011)	0.005 (0.010)	0.008 (0.012)	0.011 (0.012)	-0.011 (0.011)
Number of daily farming hours	-0.032 (0.019)*	0.001(0.017)	-0.024 (0.020)	-0.036 (0.021)*	-0.017 (0.019)
Access to extension services (1= Access, 0 = No access)	0.083 (0.070)	0.047 (0.063)	0.247 (0.070)***	0.064 (0.069)	0.128 (0.067)*
Land cultivated is within the top section of the landscape (Ref: downhill)	0.129 (0.082)	-0.236 (0.064)***	-0.035 (0.088)	-0.215 (0.082)***	-0.094 (0.079)
Land cultivated is in the middle section of the landscape (Ref: downhill)	0.066 (0.083)	-0.068 (0.070)	0.140 (0.087)	-0.146 (0.081)*	-0.125 (0.079)
Cultivated soils are perceived to be fertile (Ref: soils are not fertile)	0.198 (0.115)*	-0.220 (0.078)***	0.247 (0.122)**	-0.049 (0.129)	0.265 (0.132)**
Cultivated soils are perceived to be moderately fertile -0.045 (0.110) (Ref: soils are not fertile)	-0.140 (0.101)	-0.026 (0.121)	-0.119 (0.117)	0.093 (0.109)	
Number of different types of farm tools owned	0.070 (0.023)***	0.019 (0.019)	0.112 (0.030)***	0.066 (0.022)***	0.083 (0.023)***
Access to credit (1 = Access, 0 = No access)	-0.081(0.097)	0.133 (0.102)	-0.092 (0.108)	-0.001 (0.104)	0.105 (0.108)
Size (hectares) of land owned	-0.035 (0.020)*	0.023 (0.018)	0.036 (0.038)	0.076 (0.025)***	0.010 (0.022)
Primary (main) occupation is agriculture (1 = Yes, 0 = No)	0.396 (0.097)***	-0.090 (0.121)	0.103 (0.117)	-0.039 (0.124)	-0.106 (0.128)
Distance to nearest market is over 1 km but does not exceed 3 km (Ref: Distance <1 km)	0.079 (0.091)	0.036 (0.082)	-0.027 (0.101)	0.061 (0.092)	0.151 (0.094)
Distance to nearest market is over 3 km (Ref: Distance <1 km)	0.035 (0.082)	-0.062 (0.072)	0.185 (0.085)**	0.131 (0.082)	0.163 (0.082)**
Observations	240	240	240	240	240
Wald chi^2	36.3	44.13	45.67	38.53	39.46
Prob>chi^2	0.004	0	0	0.002	0.002
Pseudo R^2	0.106	0.147	0.202	0.111	0.131
Log pseudolikelihood	-145.822	-124.705	-131.897	-145.526	-136.732
Percent correctly predicted	58.44	25.878	48.471	42.987	34.941

The probability that a farmer will adopt Napier grass is increased by; number of different types of farm tools owned, number of extension visits received in the past 2 years, and distance range of 5.5 to 10km from the homestead to the usual point of produce sale (reference category is distance range of > 10 km). Farmers who are married are less likely to adopt Napier grass compared to their counterparts who are not married.

The only factor with a positive and significant effect on adoption of trees is size (hectares) of land owned. A negative and significant relationship was noted between adoption of trees and spending many hours daily on farming activities, and farmland being located uphill or in the middle transect along the landscape.

The following factors were found to have positive and statistically significant effect on the adoption of trenches; frequency of extension visits, ownership of many different types of farmer tools, and income. The study identified sex and mid-hill location of farmland on the landscape as the important factors that hinder adoption of trenches. Adoption of terraces is positively and significantly influenced by income and sex (1 = male). On the negative side, only uphill location of cultivated land on the landscape was found to be an important constraint to adoption of terraces.

The intensity of adoption of soil erosion control technologies is positively and significantly influenced by; distance between the farmer's residence and the usual point of produce sale, and knowledge on how to apply the different technologies. Apparently, no factor can significantly reduce the intensity of adoption of soil erosion technologies, once the farmer has decided to adopt the technologies.

Conclusion

Overall incidence of adoption of soil erosion control technologies is appreciably high – almost all farmers have adopted at least one technology. Farmer's decision to adopt contours is positively and significantly affected by the diversity of farm tools that the farmer owns and the perception that soils are fertile. Unexpectedly, doing farming as the main economic activity is associated with low probability of using contours. Facilitating farmers to own different types of farm tools, reducing the distance to output markets and increasing the frequency of extension visits will increase adoption of Napier grass. Married farmers are less likely to adopt Napier grass. Adoption of trees

will increase if farmers acquire more hectares of land. Tree planting is limited by long daily farming duration and location on the landscape – uphill and midhill. Increasing the frequency of extension visits to farmers, facilitating farmers to own different types of farm tools and increasing farmers' incomes will increase adoption of trenches. Men are less likely to adopt trenches and so are farmers with farmlands located at the middle section of the landscape. Male farmers and those with high income are more likely to make terraces on their farmlands. Uphill location is a serious limitation to adoption of terraces. Intensity of adoption of soil and water erosion control technologies is positively and significant affected by short distance to output market and possession of technical knowledge of how to apply the technologies.

Recommendations

Since farming activities of non-adopters may have negative spillover effects, effort is needed to ensure that they begin to use soil erosion control technologies. Application of some technologies – contours, Napier grass and trenches - involves use of different farm tools, yet most farmers own few types of those tools. Thus, Government programmes such as the National Agricultural Advisory Services (NAADS) are encouraged to continue supplying farm tools to farmers. The probability of adopting Napier grass and trenches increases with increasing number of extension visits received by the farmer. Therefore, NAADS should continue providing advisory services to farmers, as often as possible. Relatively short distances to output markets serve as incentive for farmers to adopt Napier grass and also to intensify the use of soil and water erosion control technologies. Therefore, increasing points of output sale would go a long way in increasing adoption of soil and water erosion control technologies. Having many hectares of land encourages adoption of trees. Government is therefore encouraged to look into the issue of small land holdings. High income facilitates adoption of technologies – particularly trenches and terraces. Government should implement in the study area, projects that will help farmers increase their incomes and therefore afford to pay for soil and water erosion control technologies. Compared to women, male farmers are more likely to adopt terraces. Thus, extension agents should purposively target women to promote adoption of terraces.

It is planned to write a policy brief using the evidence from this study. In addition, arrangements are being made to hold public dialogue with stakeholders from Uganda Ministry of Agriculture,

Animal Industry and Fisheries (MAAIF) –ministry, departments and agencies and the parliamentary committee on agriculture, during which copies of the policy brief will be distributed.

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