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IMPLICATIONS OF MARKET ACCESS ON SOIL AND WATER CONSERVATION INVESTMENT IN THE HIGHLANDS OF EASTERN UGANDA

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ABSTRACT

Market access is one of the motivating mechanisms for farmers to invest in soil and water conservation (SWC). Areas of relatively high agricultural potential but remote from major markets face numerous challenges in marketing their outputs. The objective of this study was to explore the market access determinants of farmer investment in SWC technologies in the highlands of eastern Uganda. A multi-stage sampling technique involving purposive sampling was used to determine the areas where the problem of market access is predominant. A Semi-structured questionnaire was administered to 192 randomly selected household heads. Data was analysed with soft ware packages for social scientist (SPSS). Binary logistic model was fitted to determine the influence of market access to investment in soil and water conservation. The probability distribution of the final chi-square ratio, in respect to market access, was 0.042 (<5%) implying the significant influence of market access to investment in SWC. Linking farmers to better markets for their agricultural commodities would create a positive contribution in raising high economic return and investment in SWC.

Key Words: Infrastructure development, multi-stage sampling, Sebei region, soil and water conservation

RÉSUMÉ

L'accès au march est l'un des mécanismes de motivation des fermiers pour investor dans la conservation des eaux et de sol (SWC). Les milieux constituant un potentiel agricole relativement élevé mais éloignés de grands marchés font face à d'importantes contraintes en rapport avec l'écoulement de leurs produits. L'objectif de cette étude était d'explorer les déterminants de l'accès au maché des investissement des fermiers dans des technologies de SWC dans les hautes terres de l'Est de l'Uganda. Une technique d'échantillonnage à étapes multiples impliquant un échantillonnage ciblé était utilisée pour déterminer les milieux où le problème d'accès au marché est predominant. Un questionnaire semi-structuré était administer à 192 chefs de ménages sélectionnés aléatoirement. Les données étaient analysées avec le logiciel SPSS. Le modèle logistique binaire était utilisé pour déterminer l'influence de l'accès au marché sur l'investissement dans la conservation du sol et des eaux. Connecter le fermiers sur les meilleurs marchés pour écouler leurs produits agricoles pourrait être d'une contribution positive en terme de l'accroissement du revenue économique et l'investissement dans le SWC.

Mots Clés: Infrastructure dévelopmént, echantillonnage à étapes multiples, Sebei région, conservation des eaux et de sol

INTRODUCTION

Market access has serious implications on land and water resources for sustainable agriculture and poverty reduction in many developing regions. The negative significant effect of distance to market is the increased production costs which hinder adoption of sustainable land management practices because of unsatisfactory profit margins farmers get (Gebremedhin and Swinton, 2003; Pender and Gebremedhin, 2006; Kabubo-Mariara *et al*., 2010).

Areas of relatively high agricultural potential but more remote from major markets face numerous challenges in marketing their outputs. The key challenges are inadequate and poor conditions of the transport systems including roads. These challenges are highest in agro-ecological zones of widespread poverty and fragile ecosystems (Pender and Hazell, 2000; IFAD 2001; Shiferaw and Bantilan, 2004). According to (Poulton *et al*., 2006), market failure is remarkably rampant in marginal areas where market infrastructure, viable technological options to investment in SWC and policy are lacking or under developed. Boyd and Turton (2000) and Olwande *et al*. (2009) have also indicated that adoption of land management technologies is affected by various factors including market access.

Market access in Sebei region in eastern Uganda is constrained by the poor transport net work which has been observed as the serious infrastructural bottleneck to investment in soil and water conservation (UPPAP, 2002). As a result, farmers depend on inefficient forms of transportation including animals, the donkeys and oxen to transport agricultural produce to local markets especially where vehicles cannot reach because of the steep and ragged terrain. Even as they make an effort to reach these markets, the prices for produce are very low. Farmers are therefore left in the hands of middlemen who dictate on and offer low prices. On average, a kilo of maize is sold at 0.2 US dollars as compared to the unfair price of seed bought at 2.2 US dollars a kg^{-1} during planting time. The variance is significantly big and a better alternative for farmers would be to store till the prices are fair. The challenge is, 80% of the farmers were observed to be using poor traditional food storage facilities made of small sticks and grass thatched roofs which cannot hoard more than one ton of maize grain. Where a farmer has harvested what is more than the capacity of his storage facility, he is forced to sell at the prevailing market price to avoid incurring more post harvest handling losses.

Market access has both direct and indirect effects on soil conservation investment (SCI). (Benin, 2006; Bromley, 2006; Jagger and Pender, 2006; Place and Ethui, 2006; Staal *et al*., 2006; Barrett, 2007; Stifel and Minten, 2007) urge that market access is critical for determining the comparative advantage of a particular location because of the substantial operational costs in marketing agricultural commodities. Better market access increases the adoption probabilities of conservation in SWC methods (Ersado *et al*., 2004; Nkonya *et al*., 2005). If the transaction costs are low, the sufficient market prices promote increased use of inputs such as fertilisers and higher crop yield is realised (Angelsen, 1999). With better market access, farmers can shift to production of high value crops or livestock products which increase household income and this encourages investment in SWC (Pender *et al*., 2006b).

Gebremedhin *et al*. (2004) noted that the highlands of eastern Africa are endowed with huge agricultural production potential, but farmers continue to experience high production disincentives due to lack of access to favorable marketing systems. The poor terms of trade affect commodity prices and the limited profit farmers obtain from the sale of produce is a cause of low motivation to investment in soil and water conservation measures. According to Amarasekara *et al*. (2009), and Ulimwengu and Sanyal (2011), willingness to invest in soil conservation measures increases with farm income. The increased income for farmers is attained when there is favorable market and reliable transport infrastructure. Improved market access is regarded as a driving force for igniting farmers' investment in sustainable agriculture and SWC (Shiferaw *et al*., 2009). Mowo, Mwihomeke, and Mzoo (2000) have provided evidence that farmers can increase their farm productivity by

up to five times upon adoption of soil conservation technologies.

Many studies in highland agricultural systems have focused on the agro-ecological and biophysical aspects of SWC, with little attention to socio-economic factors that influence this phenomenon (Muwanga *et al.*, 2001; Knapen *et al*., 2006; Claessens *et al.*, 2007; Buyinza *et al*., 2008; Mugagga, 2010). This study aimed at understanding the implications of market access on farmers' decisions to invest in SWC in Sebei region in eastern Uganda.

MATERIALS AND METHODS

The study area. This study was conducted in the selected districts of Sebei sub-region comprising of Bukwo, Kween and Kapchorwa which lie on the slopes of Mount Elgon in Eastern Uganda where 40% of the farmers live in less favorable locations of the region. These areas are characterised by poor market access and infrastructural network challenges and suffer from high levels of resource degradation (UPPAP, 2002; NEMA, 2004). The slopes of Mount Elgon are geographically described as having high rainfall well distributed and on average 1200 mm. The altitude ranges between 700-2800 metres above sea level with low temperatures of 31^0C and relatively fertile volcanic soil (Nkonya *et al*., 2008).

High precipitation causes land degradation and severe soil erosion because of the rugged nature of the region making it vulnerable to landslides. The roads become impassable consequently blocking access to markets for agricultural produce. The sub counties involved were Kortek, Kaptererwa, Senendet, Bukwo, Benet, Kwosir, Binyiny, Chema, Kapchesombe and Kaptanya.

Sampling. A multi-stage (three stages) sampling involving a combination of purposive and random sampling procedures were used to select a representative sample of respondents. The first step involved purposive selection of the ten sub counties (Kortek, Kaptererwa, Senendet, Bukwo, Benet, Kwosir, Binyiny, Chema, Kapchesombe and Kaptanya) with the help of the district political and technical staff where the problem of market access and its implications to investment in SWC are rampant. The second stage involved random selection of two parishes per sub-county and two villages per where data was to be collected. This brought the number of parishes to 20 and that of villages to 40. The final stage was the use of simple random sampling of household heads from the selected villages. Names of respondents were picked from village lists provided by either the Local Council one (LC 1) Chairpersons or sub county NAADS coordinators depending on who was available at that time. A rotary system was used to select 20 respondents to be interviewed in each sub county. Numbers corresponding to the name of the farmer in the list were written on small pieces of paper. The pieces were then placed in a basin and mixed up by agitating the basin. The farmers whose numbers appeared on top were the ones picked and interviewed. The challenge with this procedure was that some of the selected respondents were from very far where the road net work was poor and movement became very difficult and dangerous to use a motor cycle as the study was carried out in June 2012, during heavy rains and they could not be reached.

Data tools and methods of collection. Data were collected from the 192 randomly selected respondents by administering a semi-structured questionnaire. The questionnaire was a preferred tool because it is one quick way of data collection, easy to categorise, quantify and generalise information. Fowler (1998) has recommended the questionnaire as an effective tool for minimising biases and random error. Interviews using check lists were held with key informants (KI) in the selected sites who included the sub county NAADS coordinators, Local council five (LC 5) chairpersons, Wildlife Authority Officials, District Natural Resource Officers. This category was targeted for collection of relevant information on aspects of marketing, policies and investment in soil and water conservation. This was attributed to their vast experience in marketing activities in the region. Observation was also used to complement the other tools in understanding the type of soil and water conservation structures used, road network constraints, markets and market accessibility.

Data analysis. Both descriptive and econometric methods were employed in the data analysis. The analytical techniques applied included the chi-square test which was run to detect any systematic association between the dependent variable of interest and specific household characteristics. Frequency means, and percentages were computed for different variables.

With the econometric analysis, a logistic regression model was utilised. The key empirical question was what socio-economic characteristics and other factors influence farmers' investment in soil and water management practices. The explanatory variables included in the logit model were discussed under the section of conceptual framework.

Logit and probit models are popular statistical techniques in which the probability of a dichotomous outcome (such as willing to invest or not willing to invest in SWC) is related to a set of explanatory variables that are hypothesized to influence the outcome (Neupane *et al*., 2002). However, Pindyck and Rubinfeld (1981) acknowledged that the computationally easier logit model that is based on the cumulative logistic probability function, is useful than the other types and was suitable for this study.

The ordinary Logit (binary Logit) was used to analyse farmers' socio-economic characteristics and other factors that were hypothesized to influence farmers' investment in soil and water management practices. The two levels of investment in soil and water conservation practices lead to a binary distribution of the dependent variable (outcome) justifying the suitability of the Binary Logit Model. The model specification is provided below. The description of the variables and their measurements are presented in Table 1.

$$INVEST\ SWC_i = \alpha + \beta_i MKT\_ACESSi + \beta_2 LAND\_INCOME\_CROPS_i + \beta_3 EDUC_i + \beta_4 AGE + error..5$$

Where:
α = Constant
$\beta_1 - \beta_5$ = parameters estimated

The Logit Model fitting assumed that farmers' investment in soil and water conservation practices is influenced by their socio-economic characteristics particularly, market access as well as other parameters.

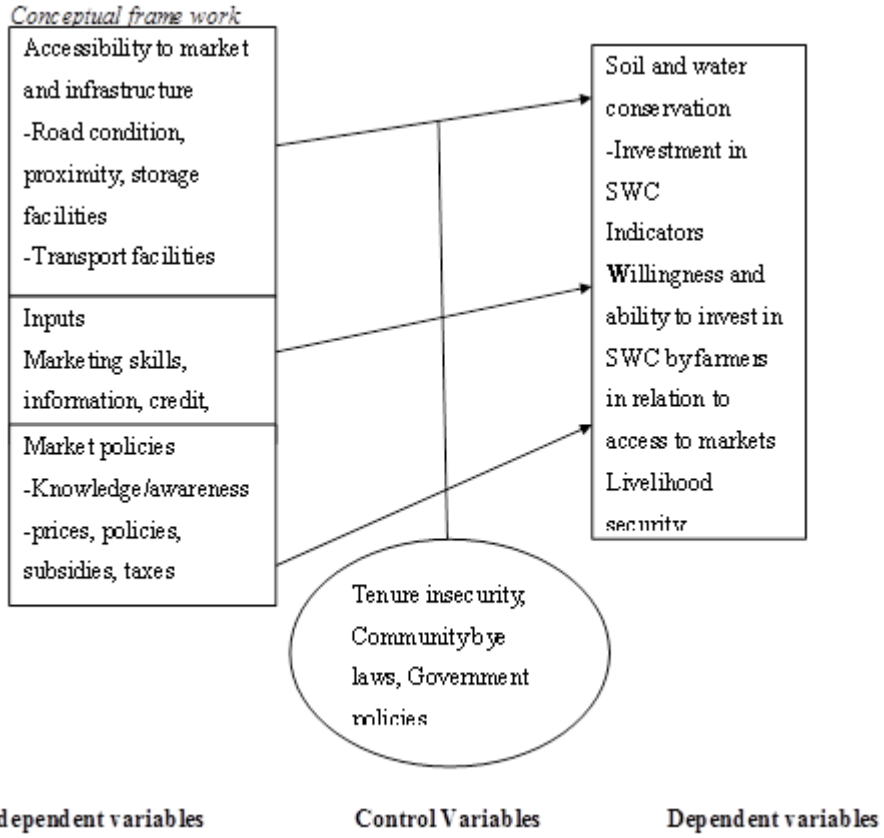
The data analysis was carried out using the statistical package for social scientists (SPSS version 16). Market access determinants were described using percentages.

The conceptual model adopted with modifications from Scherr (1996) shows the relationship between access to market of agricultural commodities and soil and water conservation investments (Fig. 1). SWC was the dependent variable measured in terms of willingness and ability to invest in soil and water conservation. The independent variables were; accessibility to market and infrastructure, input supply and market policies. The control variables were external factors on which the household had little control and included tenure insecurity, community bye laws and government policies.

RESULTS

Demographic characteristics of the respondents. From the descriptive statistics shown in (Table 1), male respondents dominated (82%) because household heads were targeted although some households were female headed. 74% of the respondents indicated that decisions made in investment in soil and water conservation involved both husband and wife. This implies that the sex of a farmer has influence on adoption of conservation measures. More than 50% of the respondents were above 40 years implying that farmers who are mature with experience in farming are likely to react in favour of conservation measures and invest more in SWC when their household incomes improve as opposed to those between 18-25 years who were found without land and spend their resources on luxurious items such as good mobile phones and other personal requirements.

Analysis showed that the literacy level in Sebei region is generally low at 22% compared to the overall national literacy rate 69% (UBOS, 2011). Education is an important aspect in soil and water conservation because literate farmers are in a better position to access market information and knowledge on SWC measures and implement.



Source: Adopted with modifications from Scherr (1996).

Figure 1. Conceptual model showing the relationship between access to market of agricultural commodities and water conservation investments

Investment in SWC is measured on the number of days a farmer is committed to find out which soil conservation measures are easy and cheap to investing. Access to market is proxy to understanding the level of participation in investment in SWC. The constraints to market access in Sebei region were majorly poor roads, low market prices and unorganised farmers. These parameters have contributed to low motivation of practicing commercial agriculture. The decrease of farmers income coupled with the subsistence nature of farming has limited input use which leads into low productivity and investment in soil and water conservation. It has been observed that farmers who live far away from the information points with fewer outlets for sales of agricultural produce are likely to be poorer than their counter parts who have access to market (Balat *et al*., 2008). Farmers also disclosed that information about market access, sustainable land management practices, improved cultural practices and soil conservation practices is among the approaches that can influence land improvement. Gebremedhin (2008) and Kassie *et al*. (2009) have hinted that access to information and availability of extension services increases investment in SWC.

DISCUSSION

The present study sought to establish the relationship between market access and investment in soil and water conservation. The binary logit model was used to analyse the socio-economic characteristics and other factors that were hypothesized to influence farmers'

TABLE 1. Demographic characteristics of the respondents

Sex of respondents	Frequency	Percentage
Male	157	82
Female	35	18
Age (years)		
18-25	25	12
26-30	27	14
31-40	28	15
41-45	36	19
46-50	38	20
Above 50	38	20
Main occupation		
Farmer	150	78.1
Business	6	3.1
Employed	24	12.5
Student	7	3.6
Unemployed	5	2.6
Ethnicity		
Kupsabiny	178	92.7
Gisu	3	1.6
Luya	11	5.7
Education level		
None	6	3.1
Primary	52	27.1
Secondary	75	39.1
Tertiary	42	21.9
University	17	8.9
Land ownership (acres)		
0-4	150	78.1
5-9	30	15.6
10-14	9	4.7
15-19	2	1.0
20-24	1	0.5
Decision in Investment in SWC		
Husband	21	16.5
Wife	9	7.1
Both	97	76.4

TABLE 2. Main income sources and food crops

Crop	Percentage (Income)	Percentage (Food)
Maize	27.7	42.2
Beans	31.8	33.1
Potato	10.4	6.5
Coffee	6.6	-
Bananas	8.5	7.7
Place where sold		
Farm gate	97	56.7
Rural market	46	26.9
Urban market	4	2.3
Farm gate and rural market	17	9.9
Farm gate and urban market	3	1.8
Others	2	2.4
Source of market information		
Others sources	88	68.2
Family and friends	92	80.0
Mass media(radio/TV	48	49.0
Market place	36	52.9
Traders	65	51.6
Extension staff	32	39.0
Print material	10	29.4

TABLE 3. Constraints in marketing agricultural commodities

Constraints	Mild (%)	Severe (%)	Very severe (%)
Poor roads	17.8	32.8	49.4
High transport costs	17.7	39.2	43.1
Low market prices	12.7	31.5	55.3
Quality problems	40.3	34	25.8
Lack of market access	34.3	33.1	32.5
Lack of market information	29.5	33.3	37.2
High local taxes	56.9	33.3	11.7
Poor storage facilities	29.5	33.3	37.3
Un organized farmers	25	44.5	28.1
High processing costs	38.8	30.6	30.6

investment in soil and water conservation in Sebei region in Eastern Uganda. The final chi-square for the log likelihood ratio was 98.06. Its respective probability distribution was 0.001 < the level of significance ($P<0.05$) indicating the overall significance of the fitted binary logit model.

The probability of the final chi-square or log likelihood ratio in respect to market access variable was 0.042 (<5% level of significance). This implied that investment in soil and water conservation practices was significantly influenced by market access. The positive sign on the β coefficient indicated that soil and water

conservation was lower among farmers whose access to market constraint was mild than those who were severely constrained. It can be emphasized that poor access to market forces farmers to sell their produce at the prevailing low prices. The meager incomes got are not sufficient to buy inputs such as fertilisers to boost soil fertility and increase crop productivity. Studies by (Pender *et al*., 2006b) have also suggested that market access boosts crop productivity. Other researchers such as Barret *et al*. (2002); Kelly *et al*. (2002), (UBOS, 2007) and Kaizzi *et al*. (2011) noted that use of artificial fertilisers is a critical SWC measure in restoring soil fertility and increasing crop yields.

The majority of the farmers sell their agricultural produce at farm gate. This was attributed to poor road infrastructure, high transportation costs and comparable market prices. The high transaction costs put off farmers in remote areas from using purchased inputs in recommended quantities, and so impeded adoption of soil conservation technologies because of the low net economic returns. Gebremedhin and Swinton (2003); Pender and Gebremedhin (2006); and Kabubo-Mariara *et al*. (2010) noted that the negative significant marginal effect of distance on increased production costs hinder adoption of sustainable land management practices.

The implication is the gradual degradation of the natural resource base (Bromley, 2008). Stifel and Minten (2008) concur that productivity is much lower in geographically isolated relative areas as compared to non-isolated areas.

Studies by Woelkel *et al*. (2002) and Gebremedhin (2004) have highlighted the effect of market access to investment in SWC. Access to markets and road infrastructre are critical for determining the comparative advantage of a particular location because of the substantial transaction costs of storage, transportation and marketing of agricultural commodities. Studies by Benin (2006); Bromley (2006); Holden *et al*. (2006); Jagger and Pender (2006); Pender *et al*. (2006); Pender and Gebremedhin (2006); Place *et al*. (2006); Barrett (2007); and Stifel and Minten (2007) have also alluded to road infrastructure and in marketing of agricultural commodities to investment in SWC.

CONCLUSION

The present study has revealed that market access and good road infrastructure can motivate farmers to invest in SWC, other production factors kept constant. This therefore implies that for soil and water conservation to succeed, especially in the highly productive but rugged mountainous regions, there is need for concerted effort, from both local and central Governments to provide and improve market and road infrastructure.

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