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Socioeconomic Impacts of Land Degradation in Mid-Hills of Uganda: A Case Study in Mt. Elgon Catchment, Eastern Uganda

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Abstract: Despite agriculture being the major sources of highland people's livelihood in Mbale region, little attention has been paid to their conservation and development. This study explores the socioeconomic impacts of land degradation in the mid-hills of Mt. Elgon catchment, eastern Uganda. The study results show that of about 59, 21, 11, 7, 3 and 2% of the average income contribution to the household economy come from off-farm, livestock, fruits, vegetables, cash and cereal crops respectively. Population densities are, in general, high in these areas and most land, including marginal lands, are under cultivation. Terracing farmland and planting fodder trees on terrace edge and on terrace risers are the traditional farming practices in order to minimize soil erosion and to maintain crop production. Slash and burn activities are continuously being practiced in the on-site for many years. Few farmers adopted soil conservation techniques such as use of mulching, hedgerows, mixed cropping of cereals with legumes and minimum tillage and establishing fruits orchards and vegetables farming. To improve the economic condition of people in the hilly area, there is a need to promote commercialization and diversification of agricultural practices with minimum degradation of natural resources.

Key words: Agricultural crops, degradation, income, soil conservation

INTRODUCTION

Agriculture is the largest sector of the Ugandan economy. About 80% of the population depends on it as the main source of income and livelihood. The agriculture resource base has been both shrinking and degrading with the increasing population pressure and marginal land with steep and very steep slopes increasingly being brought under cultivation. This has led to intense land degradation due to soil erosion in the hills and mountains (Bagoora, 1988). Cultivation on sloping and terraced land is a common feature of the Ugandan hill agriculture. The traditional farming system and cultivation on steep hill slopes have accelerated the rate of erosion and degradation. It causes severe on-and off-site environmental, economic and social impacts. To overcome these problems, research projects need to adopt a new research paradigm based on a participatory and interdisciplinary catchment approach (Boffa *et al*., 2005). The 3 key elements of this approach are: the focus on on-and off-site impacts, the provision of scientifically sound information for decision-makers and the involvement of the whole range of stakeholders from land users to policy-makers.

The challenge now is to introduce farming practices aimed at minimizing soil erosion and nutrient losses. Understanding the hydrological processes, the relationships among rainfall, runoff and sediment and nutrient transport and the socioeconomic conditions of the farmers in the area are important parts of the research. Therefore, to address these concerns IUCN has adopted a new research paradigm at the catchment-scale, based on an integrated, participatory and interdisciplinary approach for the sustainable management of land resources in the country.

The required agricultural intensification to enhance production necessitates identification of researchable priorities to provide answers to key questions pertaining to sustainable management of soil and water resources. Being soil-specific and adaptable to social and cultural conditions of the farming community, most technologies have to be refined and fine-tuned under on-farm conditions with participatory approach. The pprevious studies conducted in Mt. Elgon catchment area have primarily focused on the biophysical aspects of land conservation strategies with little attention to socio-economic factors that affect the land conservation efforts (Buyinza *et al*., 2008). This study is based on the study carried out in Mt. Elgon catchment aimed at making an assessment of the socioeconomic impact of land degradation in the mid-hills of Mt. Elgon catchment area.

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MATERIALS AND METHODS

Study area: The study was conducted around Mt. Elgon National Park ($1^0$25'N and $34^0$30^{1}E), approximately 100 km Northeast of Lake Victoria on the Kenya – Uganda border (Map 1). According to Scott (1994), Mt. Elgon is one of the oldest volcanoes in East Africa. It rises to a height of about 4,320 m above sea level. The region receives an approximately bimodal pattern of rainfall, with the wettest months occurring from April to October. The mean annual rainfall ranges from 1500 mm on the eastern and northern slopes to 2000 mm in the south and the west. On lower slopes, the mean maximum temperatures decrease from 25-28°C and mean minimum temperatures are 15-16°C.

This study was based on information obtained through a questionnaire survey, field observation and group discussions. The household survey was conducted during the months of June to December, 2005. Primary data were obtained through household survey conducted in Mutushet and Kortek Parishes, Kapchorwa District. Based on the sampling method devised by Arkin and Colton (1963), a sample size for each parish was calculated proportionally corresponding to the total number of households in the selected parish. A systematic random sampling method was adopted to select 54 households for the questionnaire survey.

Physiographically, this site is located in the middle mountain region. Settlement in the area started about 300 years ago by mainly Bagishu ethnic group. Mt. Elgon catchment occupies an area of about 124 ha and is about 6 km away from Mbale town. This site with sloping land represents a typical hill-farming situation. Deforestation leads to soil erosion, low agricultural productivity and increased household costs such as land management practices that ultimately lead to poverty in the area (Ellis-Jones *et al*., 2000). Farming much of the mid-hills and in Mt. Elgon Catchment in particular, is mostly of a subsistent nature. A majority of farm households in the area are small although there are few farmers who produce marketable surplus of fruits like orange and banana (Nabalegwa *et al*., 2007).

The biophysical and socioeconomic information were gathered through discussion with the farmers and key informants like the village head and field survey.

There could be various off-site effects of soil erosion in the downstream area and some of the potential impacts as envisaged were on the crop yields, soil properties, stream water quality, flooding and sedimentation in the agricultural land and erosion due to stream bank cutting.

Based on the potential impacts of soil erosion in the downstream areas, initial survey of farmers who could potentially be affected was conducted. They were asked about their experiences and observations on the effect of soil eroded from the upland areas. To complement the results of surveys and interviews, periodic monitoring and analysis of quality of irrigation water, soil properties and fertility status, farm inputs and crop yields of rice was conducted.

RESULTS AND DISCUSSION

Socioeconomic attributes: Of the total cultivated area of 54 ha, about 80% is used for growing cereal crops, 7% for cash crops and 3% for fruit crops. Mt. Elgon supplies all the water used for agricultural activities in the region. Two crops are mainly grown in a year. In case of lowland, only a single crop of rice is grown as summer crop and only a few farmers have recently started growing wheat as winter crop after rice. Some farmers have also grown spring maize in lowland before rice. The other crops grown in upland lands are maize, millet, buckwheat, Soybean and legumes. The overall cropping intensity is 147. Details on agricultural land, productivity of different crops and input use is presented in Table 1.

Table 1: Agricultural land, productivity of different crops and input use

Parameters	Variables	Number
Agricultural land	Total cultivated area ha.	53.55
	Average farm size	0.66
	Lowland	0.25
	Upland	0.62
Land utilization (%)	Cereal crops	80.00
	Cash crops	7.00
	Fruits	3.00
	Forest/pasture	10.00
Area (ha) and productivity (kg)	**Maize**	
	Area	28.12
	Productivity	1176.00
	Rice	
	Area	9.38
	Productivity	2257.00
	Millet	
	Area	2.27
	Productivity	867.00

Input use	Inputs (kg)	Rice	Maize	Wheat
	Seed	84.00	30	115.0
	Urea	1.67	-	7.0
	DAP	1.00	-	-
	FYM	541.00	1438	456.0

Table 2: Demography and ethnicity

Parameters	Simple variables	Number
Demography	Total No of HH	54
	Population	356
	<15 years	148
	15-60 years	185
	>60 years	23
	Male	182
	Female	172
Ethnicity	Iteso	35
	Samia	73
	Sabiny	81
	Gishu	165
	Religion HH no.	
	Christian	38
	Islam	16

Table 3: Food situation and income source

Parameters	Simple variables			Number		
Food situation (HH no.)	<4 months			3		
	4-6 months			18		
	6-9 months			19		
	9-12 months			10		
	Surplus			3		
	Average livestock herd			Av. Milk production (liters)		
Livestock (%)	Cow	Bull	Goat	Poultry	Milking cow	Milking goat
	3.5	2.0	5.2	9.7	47.4	84.0
Credit source	Formal			70		
	Informal			30		
Cash income source	Crop products			21		
	Livestock products			21		
	Off-farm			58		

There are 54 households with the population of 354 and average family size of 6.65 in the area. Main ethnic groups are Gishu, Sabiny, Samia and Iteso (Table 2). People depend mainly on agriculture for their livelihood. About one fourth of the total land is occupied by marginal and small farm households, which comprise half of the total households. About one-half of the land is under medium farm households and less than one fourth is under the large holding. Given the limited opportunities for rural employment and low agricultural production, a few households have migrated to other adjoining villages. About 62.5% of the population, mostly Sabinys and Gishus go to other districts for wage labor.

Socioeconomic characteristics and changes: Agriculture is the predominant sector of the catchment economy. About 58.6, 20.8, 10.7, 7.3, 2.6 and 2.3% of the average income contribute to the household economy from off-farm, livestock, fruits, vegetables, cash crop and cereals respectively (Table 3).

Indigenous technical knowledge: Terracing the farmland and planting fodder trees on terrace edge and terrace risers are traditional farming practices of farmers to minimize soil erosion and to maintain crop production. Farmers have also adopted clearing terrace risers by slicing and adding it to soil at least once a year during land preparation to maintain the soil fertility. Farmers apply, in general, about 10-15 tons of Farmyard Manures (FYM) in their farmland.

Relevant policies in catchment management: The Government has adopted different policies and programmes for catchment management in the country. These include mainly community and leasehold forestry programmes, afforestation in the degraded land area, terrace improvement and improvement in the farming systems. Individual approaches are needed to make intervention in the hill agricultural farming system. Among these, the Sloping Agricultural Land Technology

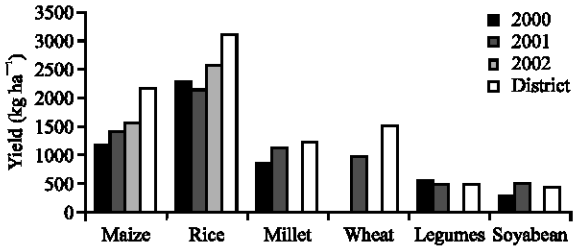

Fig. 1: Yield comparison of different crops with Mbale district production average (Buyinza *et al*., 2008)

(SALT) models were introduced in the area. Project carried out the training programmes and group discussions among farmers about these models. As a result, some farmers of the catchment have already established some hedgerows and hillside ditch in their farmland in order to reduce soil erosion. Other neighbor farmers also came to collect the information and tried to apply the technologies in their farmland.

Farmers' agricultural practices: Slash and burn activities are continuously being practiced in the on-site for many years and it is expected that it will still continue. In off-site area, these activities were done in the last year. Farmers specially those from Gishu ethnic group follow the slash and burn practice in non-irrigated marginal cultivated uplands in April and May. After these activities, farmers prepare the field for cultivation of maize, Soyabean and bean crops in the upland. About 7 households with 1.63 ha of land had followed the slash and burn activities.

Crop yield and income: Average yields of maize and rice were estimated to be 1560 and 2550 kg ha^{-1}, which have been increased by 32 and 13%, respectively as compared to in the year 2000. Their productions are still low as compared to the district average except legumes and Soybean crops but they have an increasing trend (Fig. 1).

Table 4: Farmers opinion of the technonologies promoted under PMA

PMA activity	Opinion*	Give reasons for your choice
Stream water quality	2	Dam construction, Reduce run off soil loss
Less soil erosion	2	Due to weir construction
Control of sediment loss	2	Due to weir construction
Soil fertility status	2	Reduce run off top soil
Environment conservation	4	It takes long time to evaluate
Basic food crop yield	2	Depends on rainfall, reduced nutrient loss
Cropping pattern change	2	Wheat crops and bean vegetables
Milk products	2	Grass available
Fruit trees	2	Mango and guava are still in the field
Fodder trees and grass for livestock	2	Ipil ipil grass practices
Technology development		
1) SALT farming system	3	Reduce water and top run off soil, moisture
2) Hill side ditch		
3) Intercropping farming	3	
4) Hedgerows (Alley cropping)		Vegetative barrier for sediments and runoff water and maintain soil moisture and fodder
Technical advice	2	For hillside ditch but no advice on hedgerows
Income activity through vegetables, fruits and grass	2	Bean relay with maize crop
Total member of beneficiary	2	8-10 HH benefits from control of sedimentation and soil loss
Total no. of local employed	2	2 local peoples employed in the project

*Note: *Opinion: 1 = Unsuccessful, 2 = Moderately successful, 3 = Successful and 4 = Highly successful

There were some positive effects of intervention technologies like contour hedgerows on production and productivity that takes a few years' time for their well establishment that give some visible impacts. Positive impacts of adoption of technologies on productivity were seen based on positive results in the areas.

There has been great investment in agricultural research and development of new technologies in Uganda (MAAIF, 2001). Many technological innovations most of which are appreciated or used by the farmers. According to Semana *et al*. (2002), inadequate participation of rural farmers in the agricultural technology development is partly responsible for the inability of farmers to take full advantage of the improved agricultural technologies. Agricultural technology development among smallholder farmers is still very low. To improve the agricultural production, appropriate technology is necessary to suit the local economic, cultural and geographical conditions of the region (Buyinza *et al*., 2008).

The results showed that farmers' opinion of the technologies promoted under the government Plan for Modernization of Agriculture (PMA) varied from highly successful to unsuccessful. The most popular technologies were: fodder technologies for livestock feeds; hedgerow intercropping; vegetative practices and water and land conservation technologies (Table 4).

Soil conserving farming system options introduced in the catchment: Appropriate soil conserving farming system technologies and other farmer's income generating land management technologies introduced within the catchment area for better and sustainable land and water management were as follows:

Sloping Agricultural Land Technology (SALT) farming system where perennial leguminous plant species and/or grass species, depending upon needs of farmers are grown as double line hedgerows along contours in association with annual or perennial crops in a spatial arrangement. This system once adopted can control soil erosion due to runoff water in the farmland to a greater extent and also, it helps to ensure sustainable production through the maintenance of soil fertility.

Hillside ditch farming system, where a furrow or shallow trench type hillside ditch is dug and maintained along the terrace on inner side just at the bottom of the terrace riser. This system helps in reducing soil erosion due to runoff water and also in maintaining soil moisture for a longer time, which will ultimately enhance sustainable farm production.

Inter-cropping (mixed) farming system, where leguminous crops like soybeans are inter-cropped with maize and this provides good ground cover against soil erosion and also, helps in maintaining soil fertility.

Environmental degradation: Soil erosion, deforestation and overgrazing are the key factors of decreasing per capita income. Landholdings are depicted as a result of very rapid population growth and inappropriate cultivation techniques. It is observed that the most serious problem of environmental degradation has occurred in the marginal lands. Signs of soil erosion are evident particularly on slopes of more than 20-30°.

About 87% of total households reported that soil was being washed down from their sloping land and 83% have felt the deterioration of their soil condition due to soil erosion (Nkoja, 2002). Mostly, farmers use simple conservation measures such as terracing and planting bamboos, grasses (broom grass, small bamboo and napier grass) etc. to control soil erosion and degradation in sloping land.

Intervention technologies like contour hedgerows and hillside ditch in the farming system were introduced in planting season of 2001. According to experts, hedgerows take at least 3-4 years to become well established so that their impacts on hydrological behavior and positive effects on run off and soil erosion may be observed. One farmer established hillside ditches of about 150 m long and 5 farmers established hedgerows with a total length of 2010 m. Although the area is too small to observe impacts on run off and soil erosion at the catchment level, the results obtained from the on-farm experiment showed that there was about 20% decrease in soil loss due to this technology. This is positive impact that helps to maintain soil fertility in the long run. During the discussion, farmers expressed the positive impacts of hillside ditch and hedgerow in controlling the water, sedimentation and by minimizing soil erosion loss from their fields.

The project's activities were steps towards food security for farmers in the study areas. The average yield of different crops has increased as compared to previous year. Some farmers expressed that the nutrient contents in the run off water from their fields was somewhat low so the yield of rice increased. The cropping intensity was increased due to cultivation of new crops such as wheat and vegetables in the irrigated and rainfed lands respectively. It may contribute to reduce poverty, increase livelihoods and provide food security for farmers. Farmers also practiced inter- cropping in the lowland e. g rice with soybean on the bond. They have introduced ginger as a new crop in 2001 in both on and off-site areas. Five farmers cultivated horticultural crops in upland in both on and off-site areas.

Farmers expressed their views that deposition of sand, gravel and stones in cultivated land due to flooding during heavy rainfall seemed to be low as compared to in previous years. Therefore, they did not have to clear such things and repair the terraces by themselves and that the net profit margin of the products was high in this situation. Besides these positive impacts, farmers complained about the project's negligence to maintain the irrigation channel in on-site and off-site areas. Also, there was limited employment opportunity to local people and fruits saplings and black gram seeds were not provided to the farmers.

CONCLUSION AND RECOMMENDATIONS

Agriculture is the main activity of the farm household, but it is not enough for rural livelihood. The agricultural production in the catchment area has not increased satisfactorily because of sloping terrace land, erosion problem, fragmented holding, biophysical constraints and poor infrastructure. Farmers have put a great effort to improve their living condition. But they are confronting with natural calamities (drought, heavy rain and hailstone). Efforts should be made to integrate the different farming components for the promotion of agriculture by introducing suitable crop varieties and improving farming systems like legumes, Soyabean, off-season vegetables, milk production, goat raising and fruit farming with less degradation of natural resources. Commercialization of agriculture generates farm income and increase employment opportunities in the area since the catchment is situated close to the highway.

It is possible to improve economic condition of people in the catchment area through commercialization and diversification of agricultural practices without degradation of natural resources. Due to poor economic condition of the households and poor resource base of the project site, the immediate plan for improvements as envisaged by the farmers are as follows and in this regard, it is necessary to adopt the need-based approach to development.

Being mostly a rainfed area, lands are left fallow for 3-6 months. These areas should be utilized by cultivating legumes and vegetables to increase the income of the farmers. Insects, pests and diseases are the major problems of the staple crops. In this regard, it is necessary to adopt need-based approach by introducing on-farm research and development in collaboration with extension.

Farmers should be encouraged to adopt the soil conservation techniques like mulching, growing hedgerows, mixed cropping of cereals with legumes and minimum tillage. Maize is the major crop in the area. Thus, emphasis should be given to promote the rain-fed crops like maize, Soyabean and legumes and farmers should be provided with suitable varieties of these crops.

Intensive training for control of soil erosion, livestock raising and off-season vegetable cultivation should be given to farmers so that they can take advantage of being close to the national highway and farmers of this area should be encouraged to establish fruits orchard and vegetable farming. Market-oriented high value crops like Soyabean, legumes, fruits and off-farm vegetables should be grown and training on livestock production and management should be provided to the farmers. Cropping intensity has to be increased to provide increased on-farm employment opportunities to improve the existing farmers' economic condition.

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