The linkages between land degradation, poverty and social capital in Uganda

By

Patrick Bitonder Birungi

Submitted in partial fulfilment of the requirements for the degree of

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Faculty of Natural and Agricultural Sciences
University of Pretoria
South Africa

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Dedication

To my wife Ruth, daughter Tonia and son Patrick (Jr)

Declaration

I declare that this thesis I hereby submit for the degree of Ph.D. in Environmental Economics at the University of Pretoria is entirely my own work and has not been submitted anywhere else for the award of a degree or otherwise.

Signed ……

Name Birungi Bitonder Patrick

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Any errors in thinking and omissions in this thesis are entirely my own responsibility.

Birungi B. Patrick
Pretoria, South Africa
April 2007

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By

Patrick Bitonder Birungi

Degree: PhD Environmental Economics
Supervisor: Professor Rashid M. Hassan
Department: Agricultural Economics, Extension and Rural Development

Abstract

The goal of this study was two fold. First, to investigate the determinants of soil fertility management and conservation practices in Uganda, with particular interest in the role of poverty, social capital and land tenure. Secondly, to provide an understanding of the causal relationships between social capital and household poverty in Uganda.

To achieve the above goals, econometric approaches were employed using a data set collected by IFPRI, the World Bank, and Uganda Bureau of Statistics from a survey that covered eight districts in Uganda. First to investigate the impact of poverty, land tenure and social capital on adoption of SFM and conservation technologies, a multinomial logit (MNL) model was used. Choice of the MNL model was motivated by the need to address the interdependent and joint nature of the adoption decision making. Secondly to understand the influence of social capital and other determinants on poverty in Uganda, a linear regression model was used while a probit model was used to capture the determinants of group participation our measure of social capital.

The results show that participation in social institutions generally tends to increase the probability of adopting most SFM and conservation practices and

reducing non-adoption. Social capital also reduces household poverty. The study further shows that poverty increases the probability of non-adoption. Also, land tenure security was found to be positively correlated with adoption of fallowing and organic fertilizer use and reducing the probability of non-adoption. Other key factors that affect adoption of SFM and conservation technologies, poverty and group participation include education, road infrastructure, agro-climatic differences, and household size among others.

From a policy perspective, the significance of social capital in both technology adoption and the poverty models, suggests that public investment in social capital through: capacity building programs for local groups, infrastructure support, enabling environment for their functioning (legal framework) among others would lead to poverty reduction and improved investments in SFM and conservation technologies. This can be done by incorporating social capital in key government policies such as the poverty eradication action plan and program for modernisation of agriculture. The results also suggest that poverty reduction would increase adoption of SFM and conservation technologies.

Keywords: ***Land degradation, Social Capital, Poverty, Land Tenure and Uganda***

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Glossary of acronyms and abbreviations

APEP	Agricultural Productivity Enhancement Program
BAT	British American Tobacco (U) ltd
EIA	Environmental Impact Assessment
EPRC	Economic Policy Research Centre
ERP	Economic Recovery Program
FAO	Food and Agriculture Organisation
FGT	Foster-Greer-Thorbecke
GDP	Gross Domestic Program
GNP	Gross National Product
GOU	Government of Uganda
HCCM	Heteroscedasticity Consistent Covariance Matrix
IFPRI	International Food Policy Research Institute
IIA	Irrelevance of Independent Alternatives
KACOFA	Kapchorwa Commercial Farmers Association
LC	Local Council
MNL	Multinomial Logit
MNP	Multinomial Probit
NEAP	National Environment Action Plan
NEMA	National Environment Management Authority
NEMP	National Environment Management Policy
NGO	Non-Governmental Organisation
NRM	Natural Resource Management
OLS	Ordinary Least Squares
PEAP	Poverty Eradication Action Plan
PMA	Program for the Modernization of Agriculture
SAPs	Structural Adjustment Program
SFM	Soil Fertility Management
SSA	Sub-Saharan Africa
UBOS	Uganda Bureau of Statistics

UNHS	Uganda National Household Survey
UPPAP	Uganda Poverty Participatory Assessment Project
USA	United States of America
USAID	United States Agency for International Development
WFP	World Food Program
2SPLS	Two-stage Probit Least Squares
2SCML	Two-stage Conditional Maximum Likelihood

CHAPTER I

INTRODUCTION

1.1 Introduction

Land degradation, is one major problem facing Uganda, as in much of the sub-Saharan African (SSA) countries. Exacerbated by poverty, fast growing population, and inadequate tenure security; land degradation poses a threat to national and household food security and the overall welfare of the rural population in Uganda (Nkonya et al., 2004; Nkonya et al., 2005). The problem of land degradation is more serious in Uganda, where agriculture remains the main source of livelihood contributing about 40 percent of the GDP, 85 percent of export earnings, and 80 percent of employment and provides most of the raw materials to the mainly agro-industrial sector (GOU, 2004a; NEMA, 2002). One most important feature of Ugandan agriculture is the large subsistence sector, which makes agriculture more important for food security and poverty reduction.

Land degradation in Uganda is mainly manifested through soil nutrient loss and soil erosion (Pender et al., 2004). Studies of land degradation in Uganda are limited, but available estimates indicate that the rate of soil fertility depletion in Uganda is among the highest in SSA with an estimated average annual rate of total nutrient depletion of 70 kilograms of nitrogen, phosphorous and potassium, per hectare in the 1980's (Stoorvogel and Smaling, 1990; Wortmann and Kaizzi, 1998). Soil erosion is also a serious problem especially in the highland areas of Kabale, Kisoro, Kapchorwa and Mbale in Uganda, though there is limited empirical evidence on its extent as well as its household productivity and welfare impacts (NEMA, 2002). Extent and impacts of land degradation in Uganda varies from one district to another depending on the levels of poverty, awareness of the extent of the degradation problem, availability of extension services, population density, climatic and agro-ecological differences among others.

Surprisingly, despite the level and extent of land degradation and government effort to promote use of soil conserving and nutrient enhancing production techniques, the rate of adoption of these technologies remains very low in Uganda. Technology adoption is still below 30 percent (Nkonya et al., 2004). For example, Pender et al. (2001) found that fewer than 10% of smallholder farmers in Uganda use inorganic fertilizers. In an earlier study, Woelcke et al. (2002) also show that the level of adoption of inorganic fertiliser is inadequate to halt declining soil fertility. It is estimated that smallholder farmers in Uganda apply an average of one kilogram of soil nutrients per hectare (FAO, 1999), compared to an average of 13 kilograms in SSA (Heisey and Mwangi, 1996). These rates are far from what is required to curb soil nutrient depletion given the rate of 70 kg nutrient's removal noted above.

Land degradation has been mentioned as one major constraint to improved agricultural productivity and household welfare in Uganda (UPPAP, 2002). In fact, recent household budget survey studies show that the major cause of low incomes in Uganda's rural areas has been stagnating agricultural production (Deininger and Okidi, 2001). As a result, poverty in Uganda is still pervasive and highest among those households whose main source of living is crop agriculture. For instance poverty among households headed by crop farmers increased from 39 to 50 percent between 1999 and 2002 while poverty dropped from 47 to 38 percent for those households the main occupation of which is non-crop agriculture (livestock and fishing) for the same period of time (Appleton and Sewanyana, 2003).

Using the Household survey data-2002, Appleton and Sewanyana (2003) also show that in general the proportion of the population whose incomes fall below the poverty line is 38 percent with poverty being more rampant in the rural areas where 41 percent of the rural residents are below the poverty line as opposed to 12 percent of the urban residents. This outcome is despite using poverty lines allowing higher food prices and non-food requirements in the urban areas. Apart

from the rural-urban differences, poverty also varies across regions, with the north being the most poor compared to other regions.

There is also a variation in poverty overtime. For instance, during the 1990's poverty in Uganda almost halved from 56 percent in 1992 to 35 percent in 1999/2000. Despite the progress made in the last decade, the rate of decline in poverty is still low in the rural areas. An important link between agriculture and poverty in Uganda relates to the fact that, the rate of decline in poverty in rural areas is less than in urban areas (Appleton and Ssewanyana, 2003).

Poverty has also been mentioned as one of the factors responsible for land degradation (NEMA, 2002; Shiferaw and Holden, 1999b; Nkonya et al., 2004). Poverty acts as a constraining factor on households' ability to invest in mitigating land degradation. Poor households are unable to compete for resources, including high quality and productive land and are hence confined to marginal land that cannot sustain their practices which perpetuate land degradation and further poverty (Kabubo-Mariara, 2003). The poor and food insecure households may contribute to land degradation because they are unable to keep fallow, make investments in land improvements or use costly external inputs (Reardon *et al*., 2001). Majority of the smallholder farmers in Uganda cannot afford these necessary inputs. Due to credit constraints, inadequate tenure security, as well as weak institutions, poverty can also cause farmers to take a short-term perspective, which limits the incentives for long-term investments in soil conservation (Holden *et al*., 1998; Shiferaw and Holden, 1999b; Pender, 1996).

These effects of the twin problems of poverty and land degradation require immediate public intervention. Designing appropriate intervention programs to address poverty and land degradation requires first, proper understanding of the factors that determine the adoption of soil fertility management (SFM) and conservation practices and in particular, the role of poverty in adoption of such practices and secondly to understand the factors that determine poverty in

Uganda. Given an agricultural economy like that of Uganda and the fact that government resources to eradicate poverty are limited, targeting specific aspects of poverty that critically limit farmers ability to invest in soil conservation and enhance agricultural productivity would help more rational and effective allocation of such limited resources.

Identification of the determinants of poverty and the design of government policies to address the poverty problem have been identified as priorities by the government of Uganda since the mid 1990's (GOU, 1997). The government commitment to alleviate poverty has culminated in the program for modernization of agriculture (PMA) (GOU, 2000a) and poverty eradication action plan (PEAP) (GOU, 1997, 2000b, 2004b). An important component of the Uganda anti-poverty policies focus on the provision of key services such as roads, education and agricultural extension among others. Equally important, however, is the social institutional framework through which the provision of such services may yield greatest benefits to society, but has however attracted minimum attention.

Earlier studies in Uganda attempted to explain poverty emphasising the differences in financial, physical and human capital endowments and paying less attention to the role of social capital (Appleton, 1999; 2001; Okwi, 2000; UPPAP, 2002). However, since the seminal paper by Putnam (1993b) on the role of social capital in explaining why the level of income in the northern part of Italy was higher than that in the south of Italy, there has been growing interest in understanding the role of social capital in economic development and on household welfare. Putnam's findings suggest that the regions in Italy, in which the population had a greater degree of horizontal connections (north) as opposed to vertical connections (south), had more efficient governments.

Recent analyses have demonstrated that access to social capital has a positive and significant effect on household per capita expenditure and/or incomes (Narayan and Pritchett, 1999; Grootaert, 1999; Grootaert et al., 1999; Tiepoh and

Reimer, 2004; Whitely, 2000 and Maluccio et al., 2000). In many cases, the social capital impact was as strong as and sometimes stronger than human capital impact. For instance Narayan and Pritchett (1999) in Tanzania find the impact to be 4-10 times stronger, Grootaert (1999) find the impact twice as much in Indonesia, while Whitely (2000) find the impact as strong as that of human capital.

The mechanisms through which social capital embedded in social networks, trust and norms, is said to reduce poverty can be summarised in; i) facilitating transmission of knowledge about technology and markets, reducing market failures in information and therefore reducing transaction costs (costs of obtaining information about technology, market, creditworthiness of contract parties among others). ii) Reducing problems of free riding and thereby facilitating cooperative action, iii) Coordination and monitoring effective public services delivery, iv) Ameliorating other conventional resource constraints such as market access or credit limitations and thus reducing vulnerability of households to poverty. In Uganda where most of the land is held under customary ownership, social institutions may also facilitate implementation of byelaws, which in turn may facilitate diffusion of technology.

More so, in Uganda, studies investigating how social structures that vary from one village to another may affect diffusion and adoption of SFM and conservation technologies are non-existent despite the existence of a wide heterogeneity of tribal affiliations, formal and informal social organisations in the country. This is also despite the fact that empirical literature suggests social capital affects adoption and diffusion of land management technologies (Isham, 2000; Reid and Salmen, 2000; Nyangena, 2005; Rogers, 1995). Rogers (1995) argues that the heart of technology diffusion consists of interpersonal network exchanges between individuals who have already adopted an innovation and those influenced to do so. Barbier (2000) also argues that the successes of the

Machakos[1] experience in Kenya may not be replicated elsewhere because communities in that area didn't appear to have rigid social structures, which inhibit individuals or sub-groups from collaborating.

Earlier attempts to investigate the impact of poverty on adoption of soil conservation practices in Uganda are limited. The only available studies (Pender et al., 2004; Nkonya et al., 2005) while providing good foundation for further analyses, gave inconclusive results. By using binomial decision models, the mentioned studies treat adoption choices as being independent of each other and exclude useful economic information contained in the interdependence and simultaneity of adoption decisions (Dorfman, 1996; Wu and Babcock, 1998; Bekele and Drake, 2003). Ignoring such information in the analysis may have led to the reported inconclusive results.

Secondly, the two studies on adoption of land management practices in Uganda (Pender et al., 2004; Nkonya et al., 2005) capture welfare using incomes other than consumption expenditure. In this study a consumption based welfare measure is used. The use of consumption-based, rather than income-based welfare measure has two major advantages. First, in a subsistence agricultural economy like Uganda where incomes are not regular, use of income measures would not yield adequate results. Farmers get high income during periods of harvest and receive very little during other periods. To the contrary, households spend their incomes throughout the year. Expenditure and consumption therefore is a smoother measure of welfare than income (Mukherjee and Benson, 2003). Thirdly, most of the household income in Uganda is derived from self-employed business or subsistence oriented agricultural production. Assigning income values to the proceeds of these enterprises is often problematic (Mukherjee and Benson, 2003; Hentschel and Lanjouw, 1996).

[1] See also English et al., (1994), Tiffen et al., (1994), on the success story of Machakos district in Kenya.

Verifying empirically the impact of household poverty on adoption of land management techniques is a much more complex task than what may appear at first sight. The literature postulates that poverty and adoption of various land management technologies are reciprocally interrelated. On one hand, poverty determines the level of adoption of particular technologies. At the same time however, level of adoption may have implications on land productivity and therefore on poverty. Introducing poverty on the right hand side may therefore introduce an endogeneity problem.

More so, verifying empirically the impact of social capital on household poverty is equally a difficult task. The reason is that there is also a causality problem, with some literature suggesting that the causality actually runs from household poverty to social capital. For instance, when joining associations involves actual cash contributions, poor households will choose those associations that are highly beneficial to them and/or those that do not require any contributions.

Before drawing any conclusions about the poverty-social capital relationship on one hand and poverty-adoption of SFM and conservation practices on the other, it is important therefore to follow a methodology that effectively controls for the possible endogeneity problem.

1.2 Objectives of the study

The main goal of this study is therefore two fold. First, to investigate determinants of SFM and conservation techniques in Uganda. Secondly, to provide an understanding on the causal relationships between social capital as measured by group membership and household level poverty in Uganda. Specifically, this study aims to analyse:

i) The impact of poverty, land tenure and social capital on adoption of SFM and conservation practices and which particular SFM and conservation practices are most affected by these factors.

ii) Importance of social capital in explaining the level of household poverty in Uganda

iii) Importance of poverty and other determinants in the decision to participate in social agrarian groups.

1.3 Approaches and methods of the study

As noted above, this study has two main objectives. First was to establish the determinants of SFM and conservation technologies. Secondly, to provide an understanding of the causal relationships between social capital and household poverty in Uganda. Different analytical tools were therefore used. First, considering the interdependent and joint nature of adoption decisions, a multinomial logit model (MNL) was used to estimate the effect of poverty, social capital and property rights on adoption of certain SFM and conservation practices. In this framework, farmers were expected to choose a mix of options that maximise their Utility. To correct for possible endogeneity effects, associated with the poverty-SFM and conservation relationships, a two-stage probit least squares 2SPLS was used.

Secondly, a linear regression model is used, to understand the determinants of poverty in Uganda while a probit model was used to establish the determinants of group participation. In order to correct for the endogeneity problem associated with poverty and social capital (involving discrete endogenous dependent variables), a two stage non-recursive procedure is used. The 2SPLS and two stage conditional maximum likelihood (2SCML) approaches were used to correct for possible endogeneity effects associated with social capital-poverty relationship.

1.4 Organisation of the thesis

The first chapter covered the introduction and motivation for the study. The second chapter gives a brief background on the Ugandan Economy, highlighting important issues in agriculture, poverty, and land degradation. The third chapter provides detailed description of the data and other selected socio-economic features of the study area. The fourth and fifth chapters are stand-alone papers, providing theoretical, methodological and empirical relationships being investigated. The fourth chapter for instance, discusses the role of poverty, land tenure and social capital on adoption of SFM and conservation technologies while chapter five discusses the determinants of poverty and determinants of social capital (group participation). The sixth chapter provides conclusions and policy implications based on the poverty, and the MNL models.

CHAPTER II

AGRICULTURE, LAND DEGRADATION AND POVERTY INTERACTIONS IN UGANDA

2.1 Introduction

This chapter aims to bring the perspectives of poor farmers to the fore, by providing the basis for government to address their constraints. First, the chapter highlights the importance of agriculture to the Ugandan economy and discuses the proximate and underlying causes of land degradation in Uganda. The chapter also provides a discussion on causes, nature and distribution of poverty in the country. In the last part of the chapter, a discussion of the existing institutional and policy framework for poverty alleviation and environmental management in the country is presented.

2.2 Importance and characteristics of the agricultural sector in Uganda

As already highlighted in the previous chapter, agriculture is the mainstay of the Ugandan economy, contributing about 40 percent of the GDP (see figure 2.1), 85 percent of export earnings, and 80 percent of employment (GOU, 2000a; NEMA 1999). The agricultural sector provides most of the raw materials to the mainly agro-industrial sector comprising of coffee hauling, cotton ginning, tea processing, sugar production, soap industries, edible oil, textile mills, cigarette manufacturing, grain milling, meat processing, and leather manufacturing (GOU, 2000a; NEMA 1999). It is a source of food security and remains the principal livelihood option for the poor people in the country (GOU, 2000a; Ellis and Bahigwa, 2003). Recent estimates show that about two thirds of the earned incomes of the poorest decile come from agriculture (Deininger and Okidi, 2001). While about 80 percent of the county's labour force is concentrated in agriculture, they receive less than half of the total incomes generated by the sector. Poor

smallholder farmers producing for subsistence on less than one acre of land and using traditional production techniques dominate the sector.

Nearly all the agriculture is rain-fed and uses almost no modern inputs. The agricultural sector is labour intensive depending primarily on household labour, largely comprising of women and children. For example, women form close to 80 percent of the agricultural labour force and contribute over 80 percent of all food production in Uganda (GOU, 2000a). The sector uses only a few rudimentary tools such as a hand hoe, with low mechanisation.

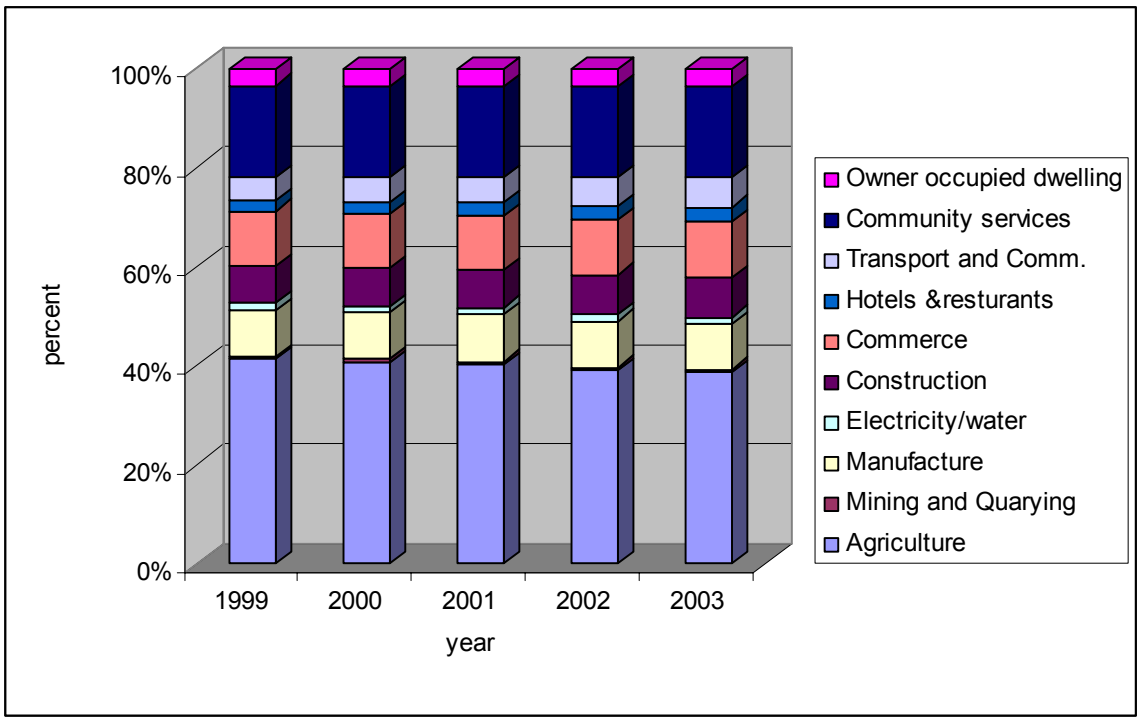

Figure 2.1: Sectoral contribution to GDP (percentage of total GDP)
Source: Constructed by the author with data from GOU (2004b)

In the early 1980's, the agricultural sector performance was very poor, recording an average growth rate of negative two percent per annum. However, following the introduction of the Economic Recovery Programme (ERP) in 1987 and the Structural Adjustment Policies (SAPs) of the early 1990s, economic growth in the country as a whole and agriculture in particular improved significantly. For

instance, the agricultural sector grew at an average rate of six percent per annum for the period 1992 –1996. Relevant policies introduced among others include, focus on rehabilitation of the infrastructure for traditional exports (coffee, cotton, tea and tobacco); development of non-traditional exports; removal of physical, technical and institutional constraints for agricultural development; agricultural pricing, trade and marketing liberalisation and strengthening agricultural research and extension.

Despite the above achievements, however, the welfare of the majority of subsistence farmers has not improved. Household incomes are still low and food security is not guaranteed. A study by the Economic Policy Research Centre (EPRC, 1998) shows that by 1998, about 40 percent of the population were considered to be food insecure. Extension services are not adequate and reach few farmers, while the rates of technology adoption for most soil conservation soil fertility management are below 30 percent. Only one third of the total food production is marketed, up to 60 percent of household expenditure is spent on food, and 56 percent of total agricultural GDP is subsistence production for own household consumption (EPRC, 1998). To make matters worse, recent estimates suggest that the declining agricultural productivity explains worsening poverty in rural Uganda (Deininger and Okidi, 2001). The next section discusses the extent and causes of land degradation in Uganda.

2.3. Extent and causes of land degradation in Uganda

As already highlighted in chapter one, there is strong evidence of wide spread land degradation in Uganda (GOU, 2004b; NEMA, 2002). The main manifestation of the degradation is soil nutrient loss, soil erosion, soil compaction and water logging (Nkonya *et al*., 2004; Pender *et al*., 2004). There is however limited empirical evidence on the economic impact of land degradation. The only available estimate of economic impact is by Slade and Weitz (1991) and is up to now still quoted in government papers. Slade and Weitz estimated that 4-12

percent of the GNP was lost due to environmental degradation. Soil erosion and deforestation contribute 85 and 15 percent of water contamination, biodiversity and topsoil loss, respectively (Olson and Berry, 2003). Soil erosion therefore remains one of the biggest environmental challenges being faced by the country at the moment. The lack of economic estimates of the impact of degradation is attributed to lack of data. Even where some data exists, the research institutions responsible for collection and dissemination of such data are not well coordinated

Available figures also suggest that while certain parts of the country such as Arua and Kapchorwa districts remain relatively under-utilized and not experiencing serious soil and land degradation problems, other areas such as Kabale and Kisoro districts are, over-utilised and heavily eroded (Table 2.1). As noted earlier, the extent and levels of soil nutrient loss are devastating. The estimated average annual rate of total nutrient depletion is 70kgs of nitrogen (N), phosphorous (P), and potassium (K) per hectare in the 1980's (Stoorvogel and Smaling, 1990). But what is more surprising is that despite the extent of the land degradation problem, adoption of technologies that could replenish the fertility or halt erosion is limited.

In Uganda, the two most fragile ecosystems are the highlands and the dry lands. As we show later on, population densities are high in the highlands and most land including the marginal lands such as wetlands and hillsides are under cultivation. There is little evidence that the increase in population densities have led to sufficient adoption of land management practices to offset worsening erosion and nutrient depletion (Nkonya *et al*., 2002). The dry land area, mostly the cattle corridor is overstocked and degraded with de-vegetation and compaction leading to erosion. The soil erosive potential of the various soils in both the highlands and the cattle corridor are also shown to be high (Figure 2.2), except for Mbarara district.

The causes of land degradation in Uganda can be classified into two categories i.e. proximate and underlying causes. The proximate causes of land degradation in Uganda include biophysical factors such as topography, land cover change, climate, soil erodibility, pests and diseases. For instance, Figure 2.2 show that the soils in the densely populated highlands of Kabale and Mbale are highly erodable and Table 2.1 shows the extent and possible causes of erosion in these districts. One would thus expect investment in conservation of practices in such areas to minimise the erosion problem.

Extent and causes of land degradation also vary across the different agro-ecological zones. Uganda's agro-ecological zones are broadly categorized into two major classifications, as Uni-modal and Bi-modal pattern rainfall zones by Ruecker *et al*. (2003). The classification was based on the average length of growing period, rainfall pattern, maximum annual temperature and altitude (Figure 2.3).

The bi-modal rainfall zone covers most of the Lake Victoria crescent southwest highlands, central and western Uganda. The uni-modal rainfall zone on the other hand covers the eastern highlands, and northern Uganda. The local distribution is influenced by the presence of Lake Victoria and local topography. The average rainfall in Uganda varies between 700 mm in the very low uni-modal areas of Karamoja in the semi-arid north eastern-part of the country to above 2000mm in Kalangala district in the Lake Victoria region. The observed bi-modal pattern is linked to the double passage of the inter-tropical convergence zone

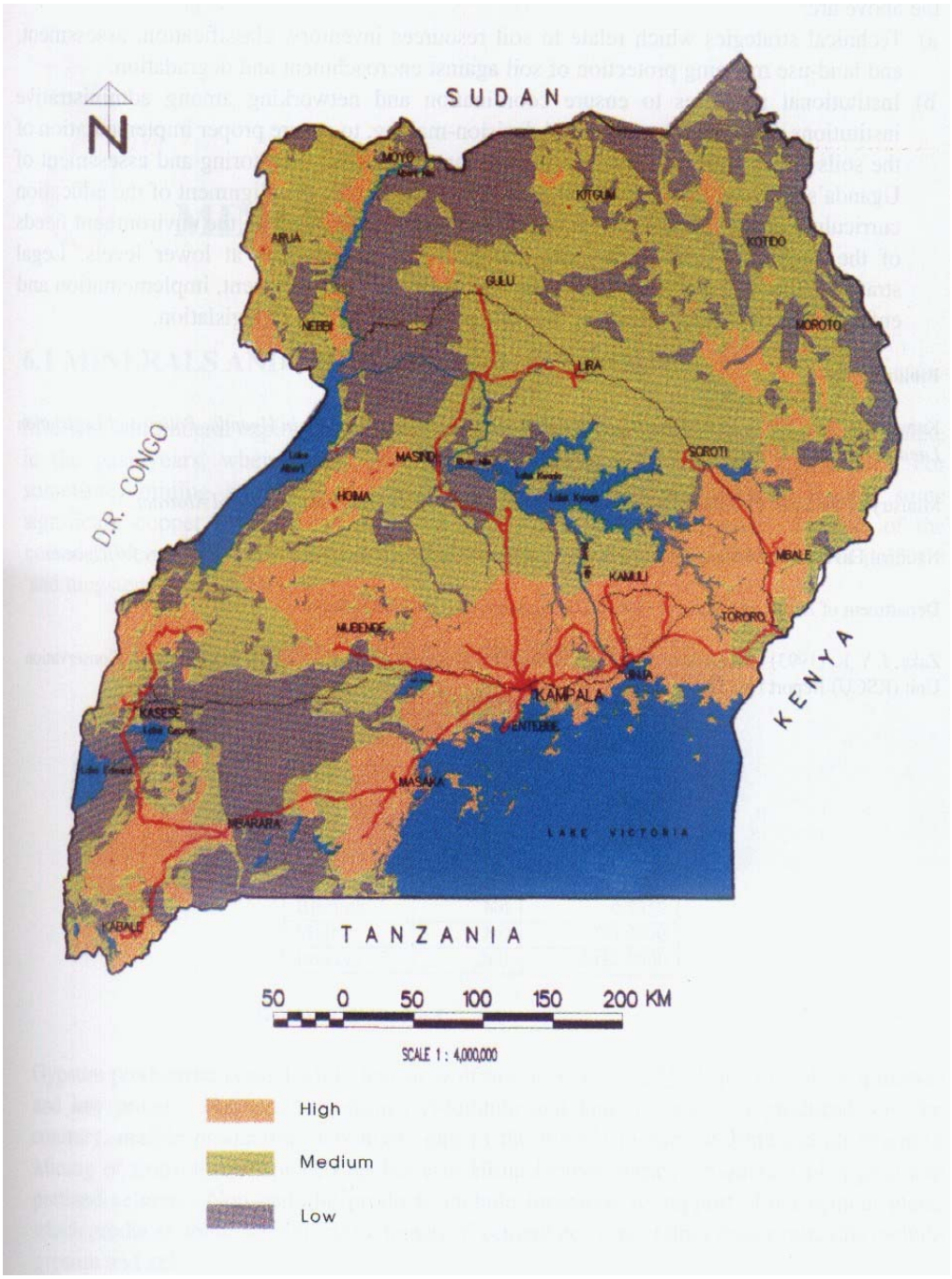

Figure 2.2, soil erosive potential of the various soils in Uganda
Source: NEMA (2002)

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The observed rainfall patterns (Figure 2.3) vary significantly across the country and such variations have implications on land management, productivity and household incomes. The rainfall patterns greatly influence local land use patterns and management and this in turn influences population distribution and provide different challenges to the population. For instance, farmers in the highland areas such as Kabale and Kapchorwa districts are expected to adopt more soil conservation structures as opposed to those in fairly flat areas of the north and north east (Soroti and Lira districts) though the latter may adopt soil fertility enhancing technologies more.

Table 2.1 Areas affected by soil erosion and the leading causes in selected districts

District	Total land Area (Ha)	Estimated area affected by soil erosion		Population density (People/km^2)	Region	Main causes of soil erosion
		(Ha)	(Percent)			
Kabale	165,300	148,770	90	250	Western	Slopes, population pressure, deforestation, poor farming techniques, vulnerable soils
Kisoro	66,200	56,270	85	279	Western	Slopes, population pressure, deforestation, poor farming techniques, vulnerable soils
Masaka	551,800	275,900	50	151	Central	Slopes, population pressure, poor farming techniques, vulnerable soils
Mbarara	1,058,700	529,350	50	88	Western	Overgrazing, bush burning, deforestation, poor farming techniques, vulnerable soils
Kapchorwa	173,800	52,140	30	67	Eastern	Slopes, deforestation, poor farming techniques,
Arua	759,500	151,900	25	82	Northern	Slopes, population pressure, poor farming techniques, vulnerable soils, overgrazing

Source: GOU (2002)

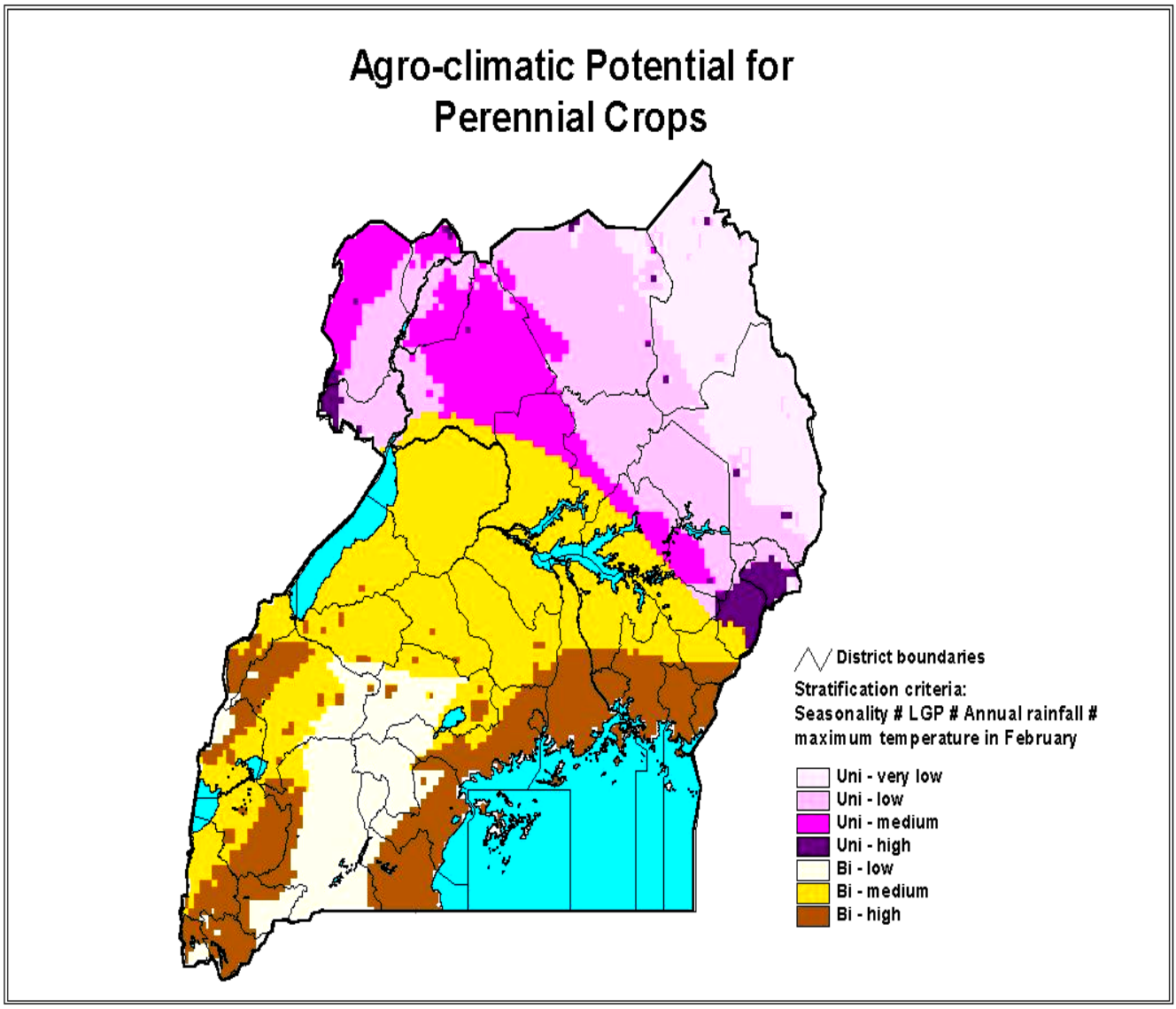

Figure 2.3: The agro-climatic potential for perennial crops in Uganda
Source: Pender *et al*., (2004)

However, many of these factors such as climate, topography cannot be influenced by policy. As a result, this chapter puts more emphasis on the underlying factors that can be influenced by policy measures. These underlying factors include poverty, policy and market failures, increasing population pressure, access to rural finance, access to markets and public services, social norms and institutions, technical assistance and basic service delivery, and land tenure systems. The diversity of these factors across the country explains the differences in levels of soil erosion and soil nutrient depletion as well as the ability/inability to manage such degradation. In the following section, key leading causes of land degradation are discussed.

2.4 Underlying causes of land degradation in Uganda

2.4.1 Population pressure

In the 1960's, the country's population was small and fallowing was possible. Farmers small or big used to cultivate the soils until such a point they observed a reduction in yield and is only then they fallow. Fallowing helped restore soil fertility and improve soil physical properties. However, with current increases in population, fallowing is no longer possible. In some districts, land has become extremely scarce and fragmented. Only 27.9 percent of households practice fallowing in Uganda and the average fallow times have decreased from 2.06 years in the late 1992 to 1.63 years in the late 2002. Such premature fallow periods have little impact on recovering fertility and hence lead to low crop yields and soil erosion, plus persistence of pests, weeds and crop diseases (Omara-Ojungu, 1992).

Population growth is considered to be one of the most important factors behind the declining use of fallows and increased land fragmentation in Uganda (Nkonya *et al*., 2004). From Table 2.3 it is also clear that population pressure is an important factor contributing to soil degradation in many of the districts in the country. For instance, the population density of 250 and 279 people per square

kilometre for Kabale and Kisoro districts, respectively, is too high. Given that these are highland areas with high erodibility potential of soils, such high population density is likely to lead to land degradation. Over the last three decades, population in Uganda has increased by 121 percent (UBOS, 2002). Provisional results of the 2002 population and housing census show that population grew at an annual average rate of 2.5 percent between 1991 and 2002 with the urban population increasing at a much faster rate than the rural population (UBOS, 2002).

Population growth affects soil degradation in a number of ways. First, rural population growth increases pressure on arable land, resulting in land fragmentation, cultivation of marginal lands, and reduced fallow periods (Nkonya *et al*., 2004; Pender *et al*., 2004; Omara-Ojungu, 1992). In fact, of the rural households in Uganda, 62 percent own farms which are less than a hectare, while 23 percent have farms which are between one and two hectares (NEMA, 2002). According to NEMA (2002), in many parts of the country vegetative fallowing has been largely abandoned, particularly in the districts of Kabale, Kisoro, Mbale and Tororo.

The expansion of agriculture into marginal areas such as wetlands, hillsides etc. due to population pressure require special attention and intervention. This practice of expanding agricultural activities to fragile lands is common in many parts of Uganda today. The situation is worsened when cultivation takes place on hill slopes where erodibility is high. Nevertheless, these marginal areas can be very productive if farmers make substantial investments on their land. Such investments include terracing, application of manure, planting of trees among others. These investments conserve soil and water at both the community and farm levels. With such investments, the food security situation will improve and other national objectives of poverty alleviation are more likely to be achieved.

2.4.2. Access to markets, roads and transport

As noted by Barbier (2000), many impoverished rural households find themselves in remote marginal areas, where access to central markets and government services is very poor. In Uganda many local farming communities have been largely neglected by government development efforts that have instead concentrated on farmers in more favourable and central agricultural areas mainly because of access. Access to markets, road and transport infrastructure is a significant problem in many areas of the country, hindering agricultural production.

Road infrastructure and market access has significant implications on productivity, and poverty reduction. Lack of good infrastructure can deter the transmission of price signals to farmers and render the production of agricultural products insensitive to price incentives. Poor infrastructure also impedes farmers' access to modern factor inputs that would enhance soil productivity. The road infrastructure in Uganda is still underdeveloped. More so, it limits the transportation of the produce to the market. More than 90 percent of the road network consists of earth and gravel and about 25 percent of the rural roads are impassable during rainy seasons. Wood, *et al*. (1999) classified the areas of relatively high market access in Uganda using the potential market integration (PMI) index, an index of travel time from each location to the nearest five markets, weighted by the population size of those markets. The areas classified as having relatively high market access include most of the Lake Victoria crescent region and areas close to main roads in the rest of the country (Figure 2.4).

About 49 percent of the total road network is all dry weather roads (dirt) (GOU, 2000a). This poses a severe problem to the agricultural sector and other sectors such as tourism, trade, and social services, especially during the rainy season when the roads become impassable. This poor state of roads limits the linkages

between sectors, undermines the proper functioning of internal markets, and increases wear and tear. Rural feeder roads are particularly critical for agribusiness and for the modernisation of agriculture.

The government has however put in place policies and programs to improve the road network. Government has accorded the highest priority to road maintenance and putting in place institutions (e.g. establishment of Road Agency Formation Unit), for road rehabilitation and construction. Government is also preparing an investment plan for prioritised rural feeder and urban roads to be implemented in the medium to the long term. This plan will also seek to strengthen institutional capacity and to ensure sustainability of the road network, among others.

2.4.3 Land access and tenure security in Uganda

Land access and prudent management and control of land is one factor that can minimise land degradation and enhance the productivity of the land as well as reduce poverty in Uganda. Given the pre-dominance of the agricultural sector noted in earlier sections of this chapter, access to land constitutes a major input to increased production. Access of the poor to productive assets such as land improves household welfare. Notwithstanding the importance of land as a productive asset, access to land by poor people is limited due to Uganda's high fertility rates and population growth rate, averaging 3.5 percent per annum in the last decade.

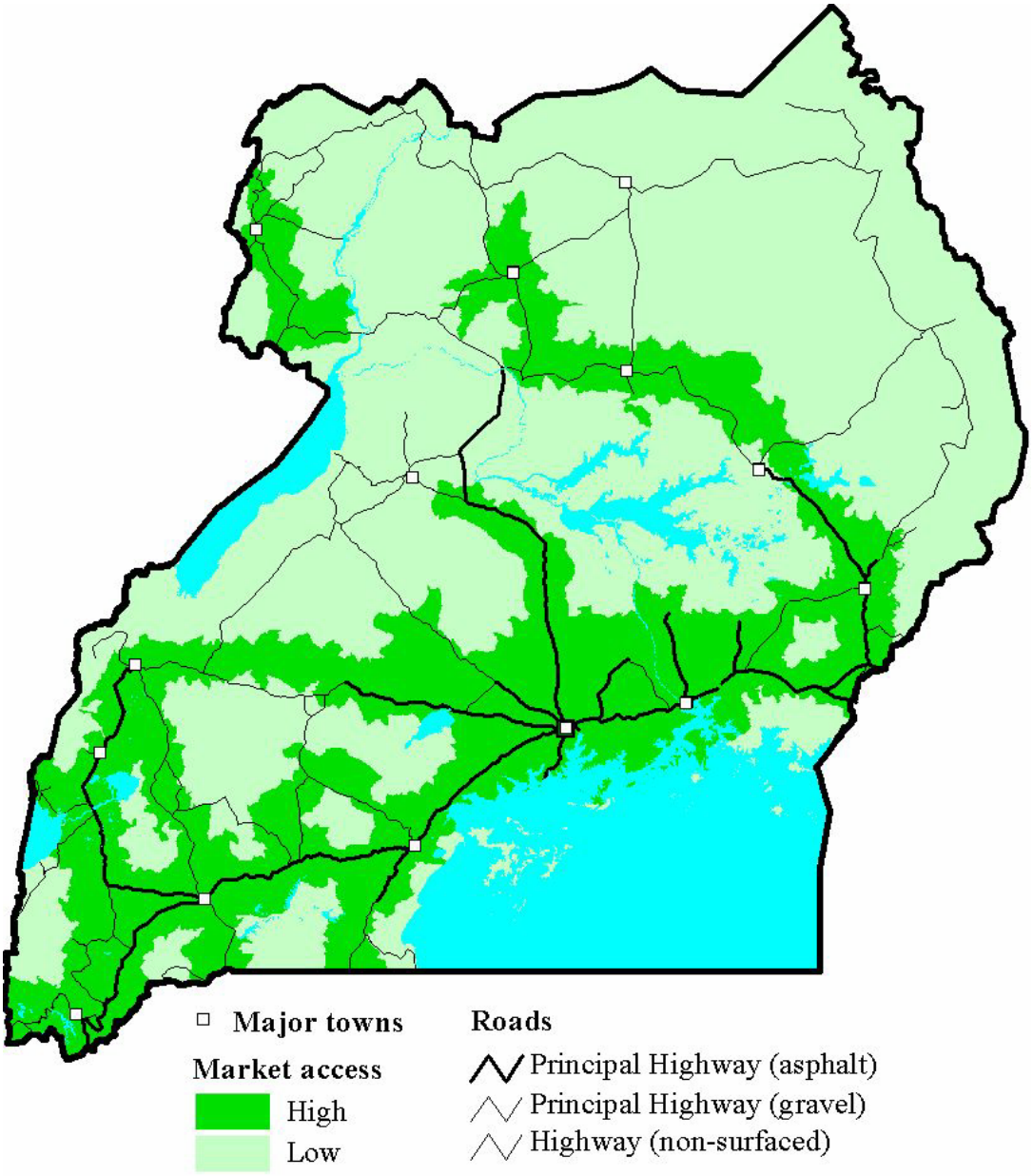

Figure 2.4: Access to markets, roads and other transport infrastructure

Source: Pender *et al*. (2004)

More so, land tenure security can influence land management, because it affects farmers' incentives or ability to invest in land improvement. For an agricultural economy like Uganda, tenure security is important for a number of reasons. First, it is argued that more secure land rights enhance investment to protect soil fertility by increasing the probability of applying manure, construction of terraces, fallowing, and the owner's propensity to rent out or sell the land. Secondly, land with secure property rights can serve as collateral for formal credit.

Thirdly, tenure security with rights of transfer and well functioning markets are important to enhance agricultural productivity and household welfare by shifting land towards its most productive use, either through sales or rentals. Movement from highly insecure to de facto tenure (introduced by the land act 1998), has significant private and market benefits, which include reduced risks of eviction, increased land values, enhancement of land markets, ability to use land as collateral, and increased investment in soil conservation and thus increased agricultural productivity.

In Uganda, the management and control of land is regulated by the land act, 1998. The act recognises four tenure systems, namely customary, *mailo*, freehold and leasehold tenure systems. Most of the land in the country is mainly customary land held either for communal utilisation or specific single permanent holdings (NEMA, 2002). Implementation of the land act however, has faced several challenges including poor human and financial resources for its enforcement.

According to the act, customary land tenure means a system of land tenure regulated by customary rules, which are limited in their operation to a particular description or class of people. Holders of land under the customary system do not have formal land titles but generally have secure tenure. Under this tenure land is divided among the different clans, who in turn divide it among the households within the clan. Households holding land under this system have

indefinite tenancy with rights to bequeath (Nkonya *et al*., 2004; Kisamba-Mugerwa, 1992).

However, there are strict rules and regulations usually enforced by the clan leaders and elders. For instance, a holder may not sell land without consulting the elders. In fact in many parts of the country, clan leaders have to meet and agree once land is to be transferred to non-members of that particular community. In this kind of tenure arrangement, the role of social institutions in enforcing bylaws is again very critical in the management of such land resources. Social institutions facilitate the monitoring and enforcement of common set of norms and sanctions at the community level. These rules and norms are normally set by elders and members at village meetings, and enforced by the communities as a whole.

However it has been observed that certain communal land resources can also be mismanaged. Some communal areas particularly within rangelands, are some times treated as open access resources in which no control is exercised in determining where, when and who utilises grazing resources (Kisamba-Mugerwa, 1992). As a result, these open access land resources have experienced significant degradation (NEMA, 2002).

In realisation of these shortcomings, the land act 1998 came in to provide tenure security for community members. According to the land act 1998, a customary tenant can be issued a customary certificate of ownership to recognise and guarantee his/her interest in the land. This certificate can also be used as collateral to get credit from the financial institutions. In addition, the act, allows for the formation of community land associations for the purposes of communal ownership and management of such land resources. These provisions provide incentives to the customary tenant to invest in proper land management practices that are long-term.

The second category of land tenure recognised by the land act is *mailo* land. *Mailo* land refers to the holding of registered land in perpetuity and having allotment of land pursuant to the 1900 Uganda agreements by the colonial masters and subject to statutory qualifications. Mailo tenure is common in the central parts (Buganda region) of the country and parts of Bunyoro. Under the 1900 agreement, large tracts of land measured in square miles were allocated to the royal family (Kabaka), other notables and the protectorate government. The landlords then divided their land into smaller parcels (*Kibanja*) that were rented out to tenants. The tenants were allowed to bequeath to their children but with some restrictions on what could be planted and when (Kisamba-Mugerwa, 1992). Eviction of tenants had also to be sanctioned by the courts of law, and in such circumstances, the tenant had to be compensated for investments on the land.

Kisamba-Mugerwa (1992) also found that within the *mailo* land, there was considerable uncertainty as to future land rights. On land occupied by tenants, it was the owner who especially felt insecure about long-term land rights because of possible land reforms. At the same time, tenants also felt insecure and did not have incentives to protect the land. As a result, large tracts of mailo land have been subjected to degradation for a long time by the tenants (squatters) who, until the coming into force of the land act 1998, did not have any secured interests in investing in the conservation of land. The act makes provision for the tenants to obtain a certificate of occupancy from a registered Mailo owner, which recognises and protects their interests in the land. This should therefore motivate the tenants to invest in land improvement technology and increase agricultural productivity.

Thirdly, freehold is the holding of registered land in perpetuity subject to statutory and common-law qualifications. This tenure system derives its legality from the constitution and is the prescribed system for registered interests outside mailo land. There are no restrictions on user rights and provides complete rights to the land owners i.e. rights to use, sell, lease, transfer, subdivide, mortgage or

bequeath the land to other generations. The act requires that all freehold landowners should have titles to remove doubts of tenure security. However, according to Nkonya *et al*. (2004), land titling is expensive and most farmers do not process title registration. For conservation interests, this particular tenure system is expected to provide maximum tenure security. However, this may not always be the case. For instance, in Uganda, studies by Nkonya et al., (2004) and Nkonya et al., (2005) show that farmers under customary tenure arrangements were more likely to use sustainable land management than those holding land under freehold tenure.

The leasehold land tenure is the holding of land for a given period from a specified date of commencement, on such terms and conditions as the Lessor and lessee may agree to. The terms and conditions of agreements however, vary greatly from one to another. The advantage of this system is that the lessor can attach conditions on management and has the right to invoke ownership if conditions are abused. Mainly because of variations in terms and conditions of the agreements, one cannot generalise on tenure security. Many leases are 49 years or 99 years. This is long enough period to encourage conservation activities and increase agricultural productivity.

From the discussion above, it is clear that the land act has many provisions to protect the land resource by providing incentives for its conservation. The law requires the owners of the land to manage their lands in accordance to the National Environmental Statute 1995 and other environmental related sectoral laws. It also provides for decentralised management of land through the district land boards together with decentralised environmental management. The challenge that remains however is for the government to enforce the provisions of the law. This calls for a proper land use policy to ease the implementation process, which doesn't exist at the moment. Unless a comprehensive land use policy is put in place, land degradation may continue unabated.

2.5 On-site and Off-site effects of soil erosion

There are numerous on-site and off-site effects of soil erosion. The on-site effects include removal of valuable topsoil, which directly affect crop emergence, growth and yield through the loss of natural nutrients and applied fertilizers with the soil. Seeds and plants also get removed from the eroded site. More so, the soil quality, structure, stability and texture can also be affected by this loss of soil. This may have detrimental effects on soil productivity. For instance, change in texture can affect the water-holding capacity of the soil, making it more susceptible to extreme condition such a drought.

On the other hand are the off-site effects that are not as clear as the on-site effects. For instance, eroded soil, deposited down slope can inhibit or delay the emergence of seeds, bury small seedling and necessitate replanting in the affected areas. Sediment can also be deposited on down slope properties, contribute to road damage, clog drainage ditches and stream channels, silt in reservoirs, cover fish spawning grounds and reduce downstream water quality. Pesticides and fertilizers, frequently transported along with the eroding soil can contaminate or pollute downstream water sources and recreational areas.

Given the importance of agriculture in Uganda and the seriousness of both on-site and off-site effects, soils must be preserved. Sometimes owners or users of land subject to erosion may have little incentive to control erosion rates if they do not show up clearly in on-site productivity losses. Even if there is an underlying trend to such losses, they are often ‘masked’ by changes in compensating applications of fertiliser.

Whereas it is in the interest of the farmers to invest in the control of on-site effects, management of off-site effects may require interventions from local social institutions, government, cross country initiatives among others. The policy implications of managing the off-site and on-site effects are different. It should however be noted that where off-site effects are quite observable and significant,

is often more profitable to control the erosion by changing management practices, e.g. construction of terraces, reduce the intensity of crops and crop rotation, agro forestry, better cover from surrounding vegetation, more organic and inorganic fertiliser applications among many others. This study however did not address the off-site effects, an externality the management of which requires measures different from those appropriate for managing on-site effects.

2.6 Poverty and land degradation in Uganda

Land degradation is having a significant negative impact on the poor in Uganda because their livelihoods depend on the quality of the natural resources. In Uganda as much as in many other sub-Saharan African countries, environmental quality is a very important determinant of the health, earning capacity, food security, energy supplies, and housing quality of the majority of the population. For instance, fertile land and adequate climatic conditions are a prerequisite for food security, and household income. As land deteriorates in quality, the poor become poorer. A study by Deininger and Okidi (2001) shows that in 1992 and 1999, rural households received about 72 percent of their incomes from own agricultural enterprises. More so, natural resource degradation, particularly with regard to the ability of soil to produce food, was actually quoted as the most central constraint to increasing food production and securing livelihoods (UPPAP, 2000). Given the over dependency on natural resources, stagnation or reduction in agricultural productivity due to land degradation imposes serious income and livelihood constraints for the rural households and therefore leading to poverty.

Poverty on the other hand has been blamed for the prevailing land degradation in the country. Poverty in Uganda affects land degradation in a number of ways. First, poverty acts as a constraining factor to households' ability to invest in mitigating land degradation. Most farmers live barely on subsistence level and do not have the capacity to use purchased inputs or to pay for labour to use the labour intensive conservation technologies. A study by Pender *et al*. (2004)

shows that there are variations across the different income groups in the use of non-labour inputs such as fertilisers, pesticides and improved seeds with the richer households using more. Use of traditional inputs was found to be more or less the same across the different income groups. The poor are also said to have limited productive assets such as land and may therefore not be able to practice simple traditional technologies such as fallowing especially in the densely populated areas. Secondly, poor households are unable to compete for resources including high quality and productive land and are hence confined in marginal lands that may not sustain their practices. According to NEMA (2002), the poor find themselves farming on steep hill slopes, and in wetlands resulting in massive erosion, drying up of reclaimed wetlands among others. The impacts of poverty on land degradation and vice verse vary across the country and over time. It is therefore important to review the trends and variation of poverty in the country.

2.7 Poverty in Uganda

Poverty is still a serious problem and more predominant in the rural areas. This situation holds even after adjusting for the cost of living differentials. Figure 2.5 and Appendix 1 show that during the period 1992/93 – 1999/2000, poverty fell in both rural and urban areas. The national poverty head count almost halved from 56 percent in 1992 to 35 percent in 1999/2000. Poverty head count fell in both rural and urban areas. The mean living standards rose faster in rural areas: the mean rise in consumption per adult equivalent was higher in rural than in the urban areas (Appleton, 1999).

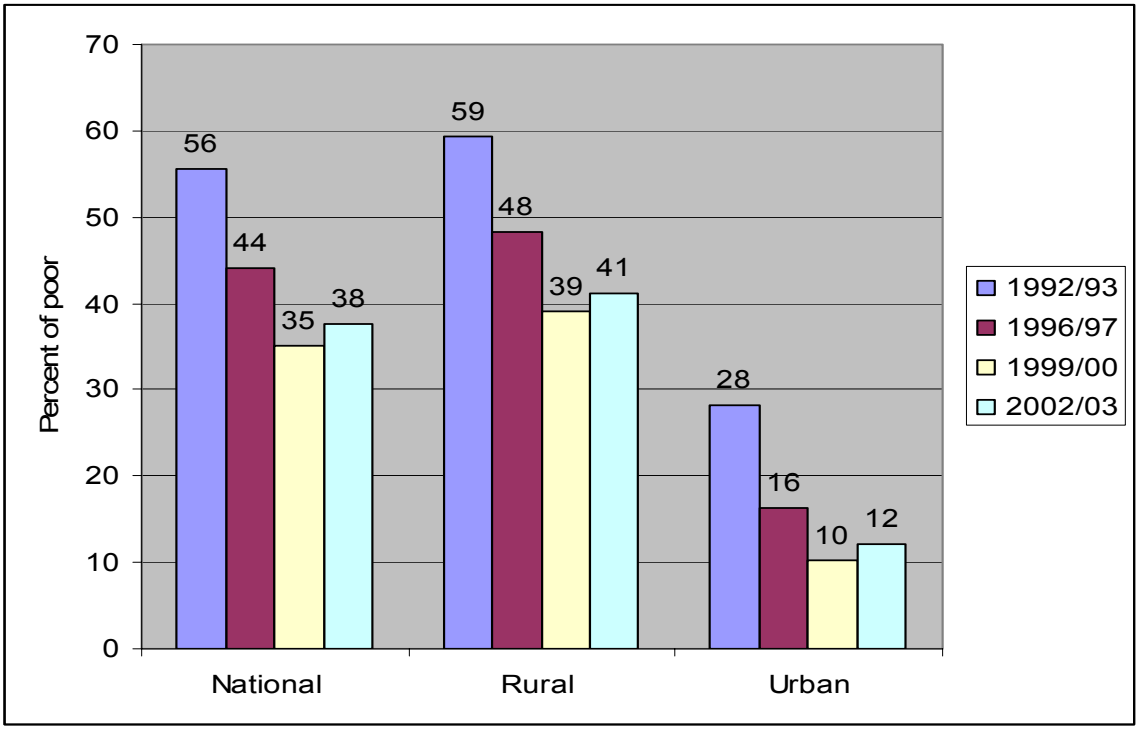

Figure 2.5: Poverty in Uganda, 1992-2003

Source: Appleton, 2001 and Appleton and Ssewanyana, 2003

Recent results from Appleton and Ssewanyana (2003) however, show that poverty in Uganda has increased to 38 percent and inequality remained more or less the same at a Gini of 0.38 in 2002/03. The recent increase in poverty has been attributed to slower growth in agriculture, declines in international coffee prices, insecurity in the northern and eastern parts of the country, high fertility rates as well as social and political factors. The incidence of poverty has increased from 39 percent in 1999/00 to 42 percent in 2002/03 and from 10 percent to 12 percent in the same period for the rural and urban areas, respectively. Worsening poverty headcount especially in the rural areas is a major concern for improvement in land management and therefore soil degradation in the country.

All regions generally experienced lower poverty between 1992 and 2000 (Appendix 1 and Figure 2.6). However, the magnitude of the fall and extent

varied greatly among regions. In general the trends have been encouraging. From, Figure 2.6, which takes into consideration only the rural strata, the northern region accounts for the highest incidence of poverty with 65% of the population being poor in 2002/03 followed by the Eastern region (48%) and lowest is the Central region (28%).

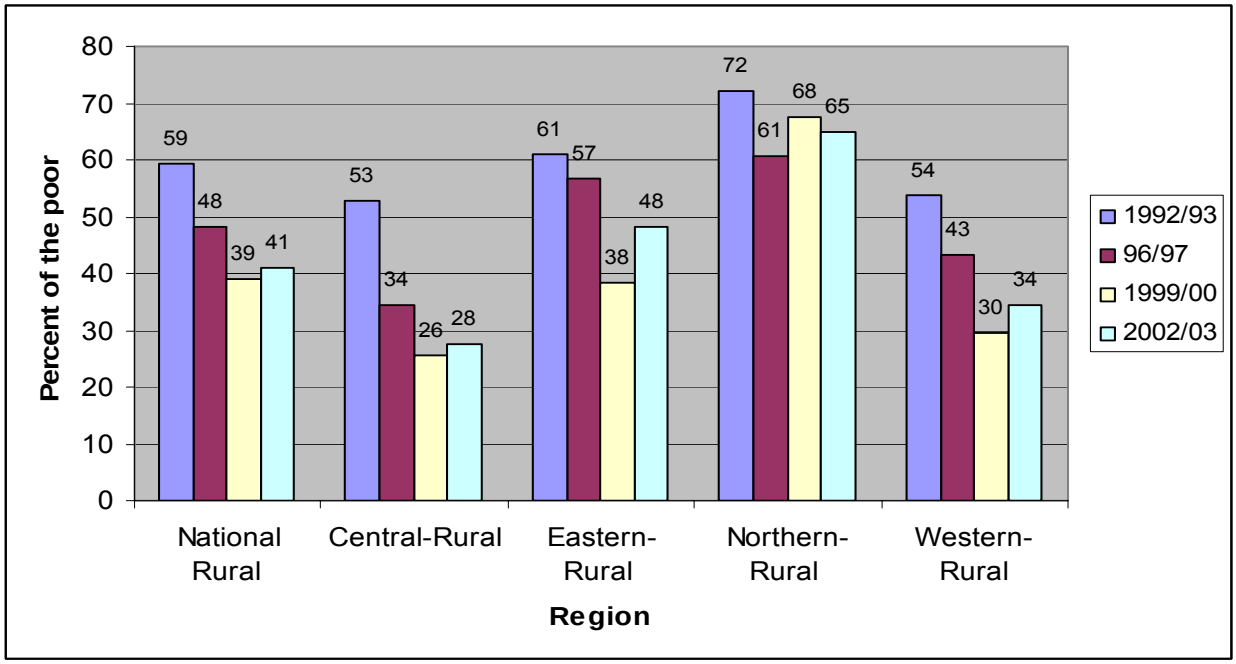

Figure 2.6: Regional distribution of rural poverty in Uganda, 1992-2003

Source: Appleton, 2001 and Appleton and Ssewanyana, 2003

Further more, poverty was higher for those households whose head works in agriculture. Poverty among agricultural households was worse for those practicing crop farming than among those engaged in non-crop agriculture like livestock and fishing. Table 2.2 shows that, between 1999/00 and 2002/03, poverty for those households in crop farming rose from 39 percent to 50 percent, while it reduced from 42 percent to 34 percent for those individuals practicing non-crop agriculture. The observed increases in poverty incidence for those households in the crop sector has been attributed to lower international prices of coffee, population growth which reduces average farm size, and reduced labour inputs in production as people switch to higher non-farm activities.

Table 2.2: Proportion of people below the poverty line by occupational group (%) in Uganda

Occupation of household head	1992	1996	1999/2000	2002/03
Food crop	64	62	45	---
Cash crop	63	46	34	---
Crop farmers	---	---	39	50
Non-crop agriculture	55	40	42	34
Manufacturing	44	34	23	28
Construction	37	35	20	23
Trade	26	21	13	17
Government services	37	32	15	13
Not working	59	60	43	38

Source: GOU (2004a)

Poverty is lowest for those households in the trade and government services sectors. The socio-economic groups that have seen falls in poverty are mainly those households in non-crop agriculture, in government services or are not working. The reduction in the non-crop agriculture arises mainly from livestock.

2.8. Social capital and the poverty-land degradation interaction in Uganda

One key area that conditions the poverty-land degradation interactions but has attracted minimum discussion in Ugandan policy papers and academic research is that of social capital. The term social capital means the rules, norms, obligations, reciprocity, and trust embedded in social relations, social structures, and societies institutional arrangements which enable its members to achieve their individual and community objectives (Narayan, 1997).

Social capital can facilitate investment in resource conservation and reduction in poverty in a number of ways. First, it facilitates transmission of knowledge about technology and markets. This can lead to reduced degradation because of the resulting adoption of technologies associated with knowledge transfer. For instance, Isham (2000) and Narayan (1997) find that villages with higher social capital were much more likely to use fertiliser, agrochemical inputs, or improved

seeds in Tanzania. The use of such inputs contributes to increased agricultural productivity, household incomes and therefore reduces poverty.

Secondly, social capital can facilitate cooperative action in resource management and thus reducing problems of free riding. Thirdly, enhancing coordination and monitoring effective public services delivery, through enforcement of local bylaws and social norms. The ability of local groups to cooperate and come to acceptable solutions can play an important role in overcoming the "tragedy of the commons". Fourthly, social capital may ameliorate other conventional resource constraints such as market access or credit limitations and thus reduce vulnerability of households to poverty.

In Uganda, the importance of knowledge and human capital in economic growth has recently been re-emphasised, particularly in the development of the PEAP for the period 2004 – 2007 (GOU, 2004b). The PEAP notes that improved capabilities can be obtained not only from formal education but also from family and village institutions, which do play an important role in local area development. These institutions may be formal or informal. The types of these institutions that exist in the country are diverse and may include, community based organisations, local village associations, elders associations, mutual self help groups, churches, government structures such as the local administrative councils, cooperatives, non-governmental organisations (NGOs), and other commercial organisations.

The aforementioned institutions differ in their respective short-term and long-term objectives and organisational structures. The objectives in many of the institutions are agreed upon by the group members and may range from the provision of community services (schools, water supply, health services, roads), to establishment of income-earning activities (poultry rearing, fishing, tree planting), to mutual assistance (building houses for members, rotating saving schemes, turn-by-turn work on members' farms-weeding, harvesting, terracing

etc), to social support (churches and mosques, burial societies, etc). Such institutions are therefore an important mechanism for social and family capital accumulation, investment in conservation activities and poverty reduction.

More so in Uganda, most of the land is customary land held for communal utilisation (NEMA, 2002). Management of such resources requires great cooperation. Wherever this kind of tenure exists, the elders normally sanction transfer of land and monitoring of violations of norms set by the communities is the responsibility of all members. Members of the communities also implement punishments such as expulsions in case of any violations. Social capital institutions are also important in resolving conflicts over inheritance and rightful ownership of land. Peasants may turn to formal legal systems when the informal systems fail. In Uganda, using the formal legal system is very expensive for the peasants as transactions costs of resolving conflicts through the formal system are very high. In rural areas, there is a heavy reliance on social relations and customary arrangements to ensure access to land.

The government of Uganda has recently recognised the role social institutions play in poverty reduction and has decided to devote funds to supplement such activities through the PEAP under a political program known as “Prosperity for all” locally known as “*Boona bagaggawale*”. The program intends to provide micro finance at reasonable interest rates to the poor and provide marketing channels for produce. According to the GOU (2004b), interventions in the social development sector are intended to strengthen the social capital of the poor. This is expected to increase social inclusion, social and economic security, and empowerment achieved through community mobilisation.

The “*Boona bagaggawale*” program is a good program because of a number of factors; government intervention in credit provision has been poor, which means that government will now avail cheap credit to rural farmers; lessen structural constraints production; and strengthen local institutions. However, the program

faces several challenges that include: politicisation of the program; sustainability of the program because it lacks a clear operational framework; management and operational constraints and sustainability of other supportive infrastructure by other arms of government.

2.9 Policy framework for poverty reduction, agricultural extension and environmental management in Uganda

2.9.1 Policy framework for poverty reduction

The most important policy paper for poverty reduction in Uganda is the Poverty Eradication Action Plan (PEAP) (GOU, 1997; 2000b; 2004b). The country's PEAP is a good attempt to integrate economic, social and environmental issues into the planning framework for poverty alleviation. It stresses the importance of ensuring the sustainability of growth; the assessment of environmental impact of government policies; and the integration of environmental issues in sectoral plans.

The PEAP is a medium term strategy for achieving the long-run government goal of poverty reduction, and economic and social transformation of the country. The PEAP framework rests on four pillars those are; sustainable economic growth and structural transformation; good governance and security; increased ability of the poor to raise their incomes and lastly, increased quality of life of the poor. In Uganda, sustainable economic growth can only be attained with proper management of natural resources, because the country's economy is heavily dependent on its natural resource base.

Within the PEAP framework, the government of Uganda has been implementing the holistic Program for the Modernisation of Agriculture (PMA) for poverty reduction. The PMA's vision is poverty eradication through profitable, competitive, sustainable and dynamic agricultural and agro-industrial sector. The PMA emphasised the transformation of subsistence agriculture to commercial

agriculture. To achieve the stated mission, the PMA is working towards facilitating the creation of an efficient competitive system for the processing and marketing of agricultural commodities and developing rural financial markets and rural infrastructure - roads, communication links, and extension services among others (Nkonya *et al*., 2004). The PMA framework however lacks well-defined linkages between agricultural policies proposed to sustainable production. Key resources for the implementation of the PMA are land, water, forests, and wetlands resources, human and social capital.

Since most of the poor, depend on agriculture as a source of income and livelihood, successful implementation of the PEAP and PMA programs and policies would lead to reduced transactions costs, which in turn leads to increased farmers' income-earning opportunities both on and off farm and therefore reduce poverty. However, though mentioned in both policy papers (PEAP and PMA), the structures through which the implementation of such programs/policies would provide better results have not been given due attention. The next subsection therefore discusses the institutions in Uganda through which implementation of such programs/policies may yield greater returns.

2.9.2 Policy framework for Agricultural Extension services in Uganda

As part of the PMA, the National Agricultural Advisory Service (NAADS) was established to replace the more generalised public extension service delivery with more focused demand-driven strategy. Under the new strategy, the farmers are expected to be empowered to purchase privately-delivered, publicly-funded advisory services. NAADS advocates for a service that is owned by and responsive to the needs of the stakeholders. The objective of the NAADS programme is to establish a system that effectively enables farmers to pursue opportunities of their own interest aimed at increasing and sustaining productivity and income.

The farmers are empowered as key partners in determining who and how agriculture, environment and market services are delivered. Currently, the program is being implemented in almost all districts in the country. In their approach, NAADS requires farmers to constitute farmer group. The district office of NAADS would then deploy one service provider to each sub-county, who meets representatives of farmer groups in farmer forums.

The farmer forums are expected to generate farmer priority service demands and contract service providers to respond to the demands. The linkage between community members and service providers though has remained a bit elusive and therefore the NAADS program has been criticised on a number of fronts.

First, the program has had implementation constraints. Some of the selected private providers lack the basic skills; there is a long biding process for service provision; corruption; low information access; and over stretched outreach program leaving limited impact in areas they service. Secondly, given it is a demand driven service, the program basically target the well to do leaving out the rural poor. The poor therefore are denied access to the all important extension services.

Thirdly, the technology being marketed to the farmers is not appropriate. For instance, there is the introduction of imported hybrid goats that have not been developed and acclimatised to the rural condition. In these rural areas, basic supplies of veterinary services are extremely limited. They need extension services that are pro-poor, that guide them on the kind of crops to plant, when, how and advise on possible sources of the market. Despite the fact that the districts covered by this study are NAADS covered, we show letter on in chapter three that farmer contact with an extension agent is about 28 percent in all districts.

2.9.3 Environmental policy and management in Uganda

Uganda's policy framework and legislation has undergone a number of reforms in the last decade. The adoption of modern technological skills in industry, agriculture and other essential aspects of the national economy have had fundamental effects on the environment in the economy. As a result, the country has therefore been compelled to modify its environmental policies and legislation to cope with these changes (NEMA 1999). Traditionally, Uganda's policy framework and legislation has been of a sectoral nature. Each line ministry would come up with a policy without adequate consultation with other key stakeholders. Recent challenges however have shown that there is a need for a well coordinated policy framework among the line ministries and other key institutions of management. The National Environment Action Plan (NEAP) made fundamental recommendations aimed at having an integrated national policy framework and legislation for sustainable maintenance, protection and exploitation of the environment and natural resources. This led to the National Environment Management Policy (NEMP) of 1994, which is the main policy statement on the environment for the country. The overall policy objective of NEMP is to achieve sound sustainable development by reconciling economic growth and conservation of resources while spearheading social development. The policy calls for the integration of environmental concerns into the economic, social and development plans, policies and programs in their sectors. The policy is legitimised by the constitution of Uganda and a number of other sectoral laws that include: the national environment statute 1995, local government act 1997, Uganda wildlife statute1996, land act 1998, water statute, 1995, and fish and crocodiles act 1964 (Sgobbi and Muramira, 2003). The sectoral laws address the main policy goals on environmental management in Uganda. These include the integration of environmental considerations in all sectoral policies, plans and programs, the requirement that all projects with potentially damaging effects on

the environment be preceded by an environmental impact assessment, and that users and polluters of the environment pay for the use and/or pollution.

The constitution requires the state to hold in trust for the people and protect important natural resources, including land, water, wetlands, minerals, oil, fauna, and flora on behalf of the people of Uganda. This is re-echoed in the land act 1998, which is intended to implement the constitutional provisions. The state is also required to promote sustainable development and public awareness of the need to manage land, air, and water resources in a balanced and sustainable manner for the present and future generations. The constitution and other legislation require the state and local governments to develop comprehensive mechanisms for the sustainable management of the natural resources.

The National Environmental Statutes, 1995, provided for the conservation of biological resources and created the National Environmental Management Authority (NEMA), which is charged with coordinating, monitoring and supervising all maters on the environment in Uganda. NEMA is empowered to issue guidelines for land use methods, which are intended to conserve biological diversity. The statute provides for new environmental management tools, including environmental impact assessment (EIA). The law also gives recognition to the need of freedom of access to any information relating to the state of the environment. In line with the decentralisation policy, the statute also requires districts to produce district state of the environment reports on annual basis. It also provides a framework for the development of targeted byelaws and ordinances on natural resource and environmental management at the local levels of governance. In line with the local government act 1997, the existing law provides for governance structures at the community and local government level including district environmental management committees, sub-county environment committees and local environment committees. This means analysis of the poverty-environmental linkage would make more sense if done at the lowest levels possible, to provide policy intuitions at the different levels.

The current legislative framework has a number of shortcomings, whereas the national environmental statute attempts to address environmental issues holistically, it does not establish a clear, well coordinated governance structure, particularly at the national line-ministry level. Conflicts over competencies to manage environmental issues arising in the various sectors, therefore still exist. To implement a number of these laws, there is need to put in place prerequisite regulations and standards. These have not yet been gazetted and therefore slowing the implementation of the laws. There are so many conflicting laws and regulations. For example, there has been a lot of confusion on how to implement the national regulations on the management of wetlands, lakeshores and riverbanks. The constitution provides for wetlands as land held in trust, which should be managed by the state for the people. In many rural areas, wetlands have been alienated under the customary land tenure system. Increasing pressure on land may therefore predispose them as agriculture and other activities expand to the marginal lands. There is need for a sectoral law on wetlands, which harmonises the land act, 1998, the national environmental statute, 1995 and the national constitution 1995. Similarly, new laws or revisions of old laws are required for forestry, mines, agriculture, fisheries and other important natural resources to ensure mainstreaming of environmental considerations into sectoral plans and policies.

2.10 Summary

This chapter discussed the importance of agriculture, and showed that agriculture is important for the Ugandan economy, not only as a source of livelihoods but also as a source of foreign exchange. The exposition of the extent, distribution and causes of poverty in Uganda shows that there are big variations of poverty levels across regions, occupations and over time.

The chapter also discussed the determinants and extent of land degradation in Uganda. The determinants covered included both proximate and underlying factors such as agro-climatic zones, terrain, population pressure, land tenure, poverty, infrastructure, social capital among others. Scientific information to quantify the impact of these factors on degradation, use of soil and water conservation technologies is limited. A review of the social institutions that exist in the country shows that many self help institutions and other formal institutions do exist in the country, though little evidence on their impact on poverty reduction and investment in conservation activities exist. Also noted the absence of social capital related studies in guiding policies in Uganda. Finally, the chapter discusses the policy framework for poverty eradication and environmental management in Uganda. The next chapter provides descriptive statistics on most of these key variables and description of the study area, and data type used in subsequent chapters

CHAPTER III

DATA AND SELECTED SOCIO-ECONOMIC FEATURES OF THE STUDY AREA

3.1 Introduction

This chapter describes the data and highlights key socio-economic attributes of the study districts. In the next sub-section, the study area and the data used are discussed while in section 3.3; selected economic indicators are presented and discussed. The chapter also discusses the associational life of the sample households in subsection 3.4. Types of the associations, and services/functions offered and prevalence of these organizations are presented and discussed.

3.2 Study area and sources of the data

Lack of comprehensive data sets that cover comparable household, plot and other environmental characteristics is a major constraint to analysing the relationship between household and plot level characteristics. This study used two data sets. First, the study had access to data from a survey conducted in Uganda in 2002 by IFPRI, in collaboration with the World Bank, and the Uganda Bureau of Statistics (UBOS). The IFPRI survey covered rural areas in eight districts in Uganda: Arua, Iganga, Kabale, Kapchorwa, Lira, Masaka, Mbarara, and Soroti (Fig 3.1). The districts were chosen to represent wide range of social, economic, environmental and institutional circumstances. The IFPRI survey collected information on plot and household characteristics as well as the associational life of these households. The main objective of the survey was to provide an understanding of the linkages between natural resource management (NRM) and poverty in Uganda.

The districts of Kapchorwa, Soroti, Arua and Lira are found in the Unimodal agro-climatic zone. With the exception of Kapchorwa, the remaining three districts are generally characterized by high poverty levels, low population densities, low average income per capita, low value of output per acre and more use of both purchased agricultural inputs and traditional land management techniques such as fallowing (Table 3.1 and 3.2). Unique features in Kapchorwa are the relatively lower poverty levels, low use of fallowing and high value of output per acre. This is believed to be due to the comparatively higher use of organic and inorganic fertilizer, organised maize farming and marketing, closeness to the Kenyan border which provides easy market access to their produce, strong presence of social capital institutions among others (Table 3.1 and 3.2).

On the other hand, the districts of Iganga, Kabale, Mbarara and Masaka are located in the bi-modal agro-climatic zone, and are generally characterized by comparatively lower levels of poverty, in spite of their high population densities. A more detailed discussion of these socio-economic characteristics is given in section 3.3 of this chapter. The districts of Mbarara, Kapchorwa Soroti and part of Masaka represent the cattle corridor, while the districts of Kabale and Kapchorwa represent the highland areas. Masaka and Iganga districts are in the high Rainfall Lake Victoria region, whereas the districts of Lira and Arua are in the low rainfall northern part of Uganda.

However, the IFPRI data did not cover key variables such as education and gender of household members and household expenditure. This information was obtained from the national household survey data (2002) since the two data sets had common identifiers.

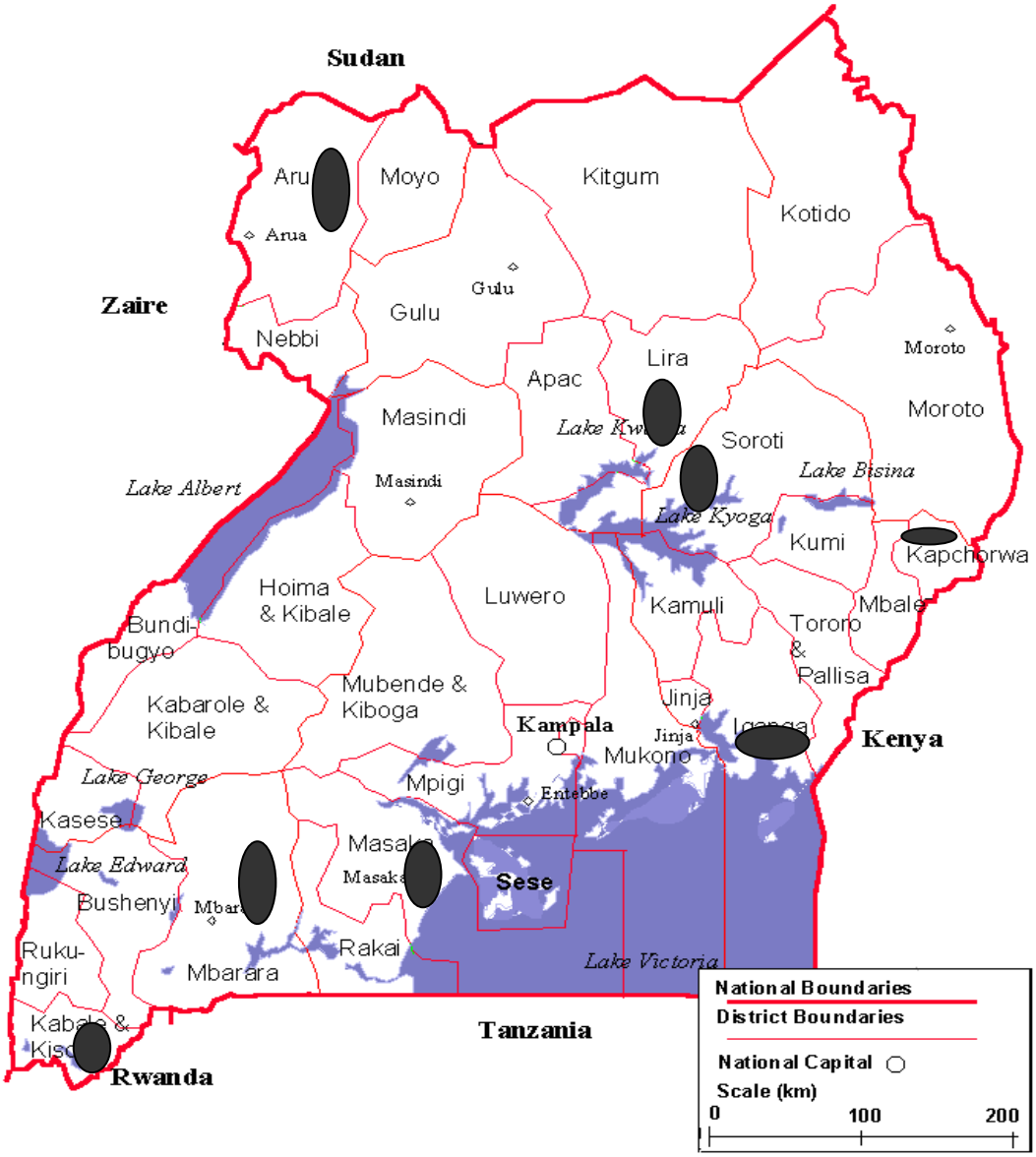

Figure 3.1: Map showing the study districts covered during the survey. The dark shadings on the map highlight study districts. The shading however may not represent the exact location of sub-counties or villages.

A stratified two-stage sampling was used to draw a sample for the Uganda National Household survey (UNHS). The UNHS covered nearly all the districts with the exception of Pader and parts of Kitgum and Kasese districts because of insecurity in those districts at the time, which also do not form part of the sample for this study. A total of 972 enumeration areas (565 rural and 407 urban) were randomly selected in the first stage of sampling from which a total of 9,711 households were randomly selected in the second stage. Sampling was proportional to population density of each district. The IFPRI data used in this study was derived from a sub-sample of 123 enumeration areas. The IFPRI survey focused on rural enumeration areas as the sampling frame since the main objective of the survey was to collect in-depth natural resource management data (Nkonya et al., 2005). A total of 851 households were selected in the IFPRI survey.

The IFPRI survey administered three questionnaires at household, plot and community levels. This study however utilized only the household and plot level data. The data collected covered a number of sections that included household composition, human and social capital, livestock assets, land use, tenure and market. A number of questionnaires were left out of the analysis because they were considered incomplete or unreliable. Some questionnaires were left out because the data appeared to have extreme values than were expected. The collected data are used in the following sections to provide some descriptive background to the study area and context.

3.3. Selected socio-economic characteristics of households in study Districts

3.3.1 Incidence and levels of poverty

Poverty levels (head count and poverty gap[2]) are lowest in the districts of Masaka, Kabale, Kapchorwa and Mbarara and highest in the districts of Arua, Soroti, Lira and Iganga (Table 3.1).

The figures presented in the tables compare well with other national averages reported in several government reports (GOU, 2004a; 2004b; Appleton and Sewanyana, 2003). For instance, Appleton and Sewanyana (2003), report 42 percent of the rural population to be poor based on headcount, which compares well with 44.7 percent reported for this sample (Table 3.1), in spite of the fact that all districts covered by the 2002 household survey are not included in the IFPRI survey.

Table 3.1: Poverty indices and other household and area characteristics by district

District	Head Count (%)	Poverty Gap (%)	Average income per capita (Ushs per month)	Value of output per acre (Ushs per annum)	Population density (people per Km^2)	Agro-climate
Masaka	35.9	8.9	27,910.36	325,308.4	151	Bi-modal
Iganga	56.2	15.2	36,992.25	201,794.2	288	Bi-modal
Kapchorwa	13.3	2.1	46,335.75	563,978.1	67	Unimodal
Soroti	47.6	21.6	20,861.96	327,043.3	50	Unimodal
Arua	67.3	21.3	18,532.03	307,719.6	82	Unimodal
Lira	66.7	25.6	16,567.77	48,128.9	70	Unimodal
Kabale	37.6	9.6	27,631.81	549,003.6	250	Bi-modal
Mbarara	37.9	12.6	28,017.69	718,606.9	88	Bi-modal
All	44.7	12.9	27,695.52	438,928.9	92	

Source: Author's calculations and NEMA (2002)

As expected, poverty is comparatively lower in all the districts that are located in the bi-modal agricultural zones, with the exception of Kapchorwa district.

[2] The head count index simply measures the proportion of the population below the poverty line while the poverty gap on the other hand measures the depth of poverty. See appendix 4 for a complete exposition of these measures.

Uganda's agro-ecologies are broadly categorized into two major classifications, as Uni-modal and Bi-modal rainfall zones by Ruecker et al. (2003). This classification was based on the average length of growing period, rainfall pattern, maximum annual temperature and altitude. The districts in the Uni-modal zone are also characterised by low population densities, average income per capita and value of output per acre (Table 3.1).

There is a significant difference in mean incomes per capita (Pr=0.0006), and mean value of output per acre (Pr=0.0005) between Unimodal and bi-modal agro-climatic zones. This seems to suggest that the favourable climatic conditions such as long growing periods, rainfall patterns among others in the bi-modal zones may partly explain differences in poverty levels, earning capacity and agricultural output.

3.3.2 Land management practices by district

Table 3.2 shows that the extent and types of technologies adopted vary from one district to another. Fallowing is practised in almost all districts except Kapchorwa district with the greatest use in the northern districts of Lira (86.2%), Soroti (80%) and Arua (46.9%). These districts have low population densities and therefore fallowing is relatively feasible. Secondly, with availability of land, it is one of the cheapest available alternatives for the poor. Probably that partly explains why it is mostly used in the poor districts of the north. In fact fallowing was the only reported practice in Lira district, which is one of the poorest. In the more densely populated districts of Mbarara, Iganga and Masaka fallowing is not a major practice as only 10-13 percent of the population practice fallowing.

Surprisingly, 35.8 percent of the sampled households in the densely populated district of Kabale practiced fallowing. An earlier long-term study by Lindblade et al. (1996), have also found that fallowing in Kabale increased with increases in population, and attribute this finding to a long historical colonial legacy of encouraging use of terraces, fallowing and other land management practices in

the district. The British colonial masters in the early 1960's were worried about population growth in Kabale and invested in extension service to encourage use of soil conservation technologies.

Overall however fallowing remains the most commonly used practice in many parts of the country, but the length of fallow has been changing overtime. For instance, the data show that the average fallow period has decreased from 2.06 years in the late 1992 to 1.63 years in the late 2002. Such premature fallow period have little impact on recovering fertility and hence lead to low crop yields and soil erosion, plus persistence of pests, weeds and crop diseases (Omara-Ojungu, 1992).

Organic fertiliser use is comparatively more common in the districts of Kapchorwa (28.9%), Mbarara (24.8%) and Masaka (18.1%). Possible explanations for this outcome are first, Kapchorwa, Mbarara and part of Masaka are cattle keeping areas and use of animal manure is a common practice. Secondly, the ability to pay for labour, since use of organic fertiliser is a labour intensive activity. What is surprising however is the low use of organic fertiliser in Soroti district, which is another major cattle keeping district (Table 3.4). Instead however, Soroti relies more on fallowing as a key SFM practice due to very low population density.

Table 3.2: Land management practices by district (% of farmers)

Districts	Fallow	Organic fert.	Inorganic fert.	Terracing
Masaka	10.40	18.04	1.22	0.92
Iganga	12.96	12.15	1.39	0.00
Kapchorwa	0.00	28.85	15.72	16.98
Soroti	80.00	5.00	5.00	0.00
Arua	46.90	4.40	7.56	4.26
Lira	86.21	0.00	0.00	0.00
Kabale	35.84	7.78	2.41	19.88
Mbarara	12.71	24.82	1.37	9.28
All	27.90	12.61	4.14	9.50

Source: Author's calculations

Inorganic fertiliser use is substantially low in almost all districts. Compared to other districts, use of inorganic fertiliser is relatively higher in Soroti, Kapchorwa and Arua districts due to organised input supply for maize and barley farmers in Kapchorwa (15%) and tobacco farmers in Arua (7%) districts and comparatively better extension services in Kapchorwa and Soroti districts (Table 3.4). In Kapchorwa district, maize and barley farmers get inputs through a well organised local association, the Kapchorwa Commercial Farmers Association (KACOFA), while tobacco farmers in Arua get their inputs from British American Tobacco (U) ltd (BAT). Farmers are assured of markets for their produce through the same institutions and costs of inputs are deducted directly from their payments.

Generally however, use of inorganic fertiliser is not a common practice in all the other districts and Uganda in general. In an earlier study, Woelcke et al., (2002), show that the level of adoption of inorganic fertiliser is inadequate to halt declining soil fertility. FAO (1999) reports that 95 percent of inorganic fertiliser use is by large-scale plantations and only five percent is accounted for by the small holder farmers.

A number of reasons may explain this low use of inorganic fertiliser. First, is the lack of an effective agricultural extension program. For instance, only 28 percent of the population had a single visit of an extension agent in the year, 2002. This limits adoption since inorganic fertiliser is new to many households in the country. Secondly, the level of profitability of agriculture in Uganda is very low (Nkonya et al., 2002). Low profitability limits farmers' ability to apply adequate inputs necessary for addressing the level of fertility loss. Third, poverty is high among the rural smallholder farmers, and as a result, cannot afford the purchased inputs such as inorganic fertiliser.

Terracing is comparatively more practised in the highland districts of Kapchorwa (16.98%) and Kabale (19.88%) as well as in the hilly district of Mbarara (9.28%).

This is again expected, because farming in these districts takes place on steep slopes and terracing is inevitable to ease soil erosion. However Miiro (2001) reports that terraces are being destroyed to access more fertile portions of the terrace, to control rodents or reduce landslides.

3.3.3 Household income, assets and demography

Across income quintiles, some interesting observations do emerge. As expected, the non-poor households (Top quintiles) have more livestock assets, are more educated, and earn more non-farm income. Total livestock assets, years of education, and non-farm income, all increase the richer the household becomes (Table 3.3). Education is expected to provide alternative opportunities for salaried employment off farm and increases the ability to startup various non-farm activities (Deininger and Okidi 2001). This finding partly explains the result that the higher the education level, the richer the household becomes and the greater the non-farm income (Table 3.3).

With the exception of the second quintile, there is no significant difference in average farm size among the remaining income quintiles. This finding may be surprising but given the different tenure systems across the country, and variations in population densities, this outcome is possible. Table 3.4 shows that the average farm size in the poor districts of Lira and Soroti is more than four acres and much bigger than in other well to do districts of Masaka, Kapchorwa, Kabale and Mbarara.

Table 3.3 selected socio-economic characteristics by income groups

Income Quintiles	Livestock assets*	Farm size (acres)	Education (years)	Non-farm income (millions of shs**)	Number of parcels	HH-size
Bottom	1.84	1.76	3.82	0.24	3.09	6.60
2nd	1.85	1.21	5.53	0.30	4.43	6.47
3rd	2.49	1.52	5.56	0.53	4.99	5.98
4th	2.67	2.01	6.87	0.50	4.93	5.98
Top	3.42	1.94	8.41	0.57	4.21	5.41

Source: Author's calculations. * Livestock is measured in tropical livestock unit (TLU). Average TLU for common livestock in Uganda is cow = 0.9, Oxen = 1.5, sheep or goat = 0.2, calf = 0.25. ** Uganda shilling to USD exchange rate was approximately $1=1800.

Also interesting to note is the negative relationship between household size and income. Dasgupta (1995; 2000) discusses several reasons in support of this finding. First, in areas where savings are low and public support for the elderly is non-existent, the poor households look at children as a source of security in their old age and a source of income earning assets. Secondly, the poor do not have information on modern family planning methods, compared to their educated rich counter parts. More educated women for instance tend to have a higher opportunity cost of child bearing and raring and in general have lower fertility. However, large family size is associated with greater labour force available for the households and can therefore serve to ameliorate labour constraints.

The average age of the household head range between 38.4 years in Mbarara district to 43.9 years in Kabale (Table 3.4). The family size is generally high at an average of 6.2 persons per family, with the lowest of 5.3 in lira district and the highest of 6.9 persons in Iganga district. Overall, most of the sampled household heads have spent 5.8 years in school with the highest of 6.97 years in Mbarara and a lowest of 4.6 years in Arua district. Most of the households are male headed with less than 25 percent of the households in all districts being female headed.

Access to non-farm income is highest in the districts of Masaka (0.583 million shs) and Mbarara (0.572 million shs) per annum and lowest in the districts of Soroti (0.146 million shs) and Arua (0.291million shs). Lack of diversified earnings could therefore partly explain high levels of poverty in some northern districts. The districts of Mbarara, Soroti, Lira and Kapchorwa are the major livestock districts. Livestock ownership is also crucial in production and investment in land management. First, livestock is a good source of animal manure and hence cattle keeping are associated with more use of organic fertilizer. Secondly, livestock can be considered as a social insurance mechanism that can be sold off especially in bad years to offset other financial shortfalls such

as the purchase of inputs for agricultural production, fees for school going children, medical bills among others.

Extension service is very poor in the country. For instance, only 28 percent of the sample households are reported to have had a single visit of an extension agent for a period of one year. The worst service was reported in the districts of Iganga (11.9%) and Lira (18.2%) while higher extension visits were reported in the districts of Masaka (36.2%), Soroti (42.9%), Mbarara (34.6%) and Kapchorwa (33.8%).

Table 3.4: Selected social, environmental and economic characteristics by district

Variable /District	Masaka	Iganga	Kapchorwa	Soroti	Arua	Lira	Kabale	Mbarara	ALL
Bequeath (dummy)	0.726	0.619	0.869	0.667	0.885	0.818	0.854	0.815	0.812
Distance from plot to Residence (Kms)	1.535	0.619	1.997	0.108	0.610	0.378	0.916	0.411	0.905
Dist from plot to nearest MKT (Kms)	3.047	2.631	2.083	2.357	1.616	2.614	4.646	3.754	3.155
Dist from plot Seasonal Road (Kms)	0.412	0.658	0.447	0.114	0.677	0.220	0.812	0.317	0.598
Perceived nutrient deterioration (dummy)	0.461	0.438	0.656	0.524	0.524	0.273	0.337	0.597	0.467
Extension (dummy)	0.362	0.119	0.338	0.429	0.285	0.182	0.250	0.346	0.281
Household Head age (Years)	42.43	38.58	40.29	38.62	41.73	42.06	44.00	38.39	41.61
Household Head Education (Years)	6.289	5.898	6.675	5.238	4.563	6.333	5.619	6.970	5.779
Household size (number)	6.560	6.907	6.644	6.238	5.472	5.303	6.098	6.480	6.186
Household Head Sex (dummy)	0.802	0.832	0.819	1.000	0.758	0.939	0.845	0.893	0.825
Non-Farm Income (millions of Ushs)	0.583	0.467	0.400	0.146	0.291	0.440	0.335	0.572	0.412
Farm size (acres)	1.683	2.927	1.108	4.333	1.730	5.174	0.682	2.068	1.611
Livestock (Tropical Livestock Units)	1.656	1.130	3.283	7.188	2.932	4.106	1.447	5.342	2.527

Source: Author's calculations.

3.3.4 Plot and farm characteristics

Tenure security is generally more stable as more than 61 percent of the plots covered in all districts can be bequeathed to next generations (Table 3.4). Bequeath in this case measures long-term security with all user rights. Secure tenure rights on land increases incentives for smaller rural farmers to invest in long-term conservation measures such as soil conservation structures as well as use of soil nutrient enhancing techniques.

Farmer awareness has been found to be an important constraint to positive adaptation to environmental changes and also a constraint to making appropriate investments in land for conservation. As for perceptions of households regarding level of nutrient depletion in covered plots, an average of 46.7% of the respondents observed severe nutrient depletion. Observations of nutrient depletion were highest in the district of Kapchorwa (65.6%) compared to a low of 27.3 percent in lira district. This probably partly explains the high use of inorganic and organic fertilizer in Kapchorwa and low or no reported use in Lira district. From a policy perspective, it is important to provide adequate information about natural resource status to the key stakeholders. Farmer education through extension services or through demonstration plots about the status of the resource base, and gains arising from proper natural resource management would be important in this case to trigger adoption.

The mean distance from residence to plots is about 0.9 kms with the longest average distance of 2 kms reported in Kapchorwa district and lowest of 0.12 kms in Soroti. This could partly be explained by terrain differences in these districts, since distance information was collected based on individual approximations of distance rather than actual measurement (Kapchorwa is in the highlands while Soroti is mostly flat land). Surprisingly, distance from plot to market and seasonal roads are longer for relatively well to do districts of Masaka, Kabale and Mbarara as opposed to those in the relatively poor districts of Soroti, Arua and Lira. Other studies in Uganda (Nkonya et al.,

2004; Pender et al., 2004) have come up with similar or inconclusive results on the role of roads on adoption of natural resource conserving technologies, agricultural production, and/or poverty reduction. Pender et al. (2004) suggest a possible explanation to be that road access favors non-farm income activities and immigration of poor people.

3.4 Social capital and associational life in the study area

The IFPRI survey also collected information on the associational life of households. The analysis shows that social networks are strong at the inter-household level and in horizontally structured organizations. A few structures associated with local leadership were however found to be hierarchical in nature. For example, the government management system was found to have a reporting structure from local council one (LC1) to local council five (LC5) at village and district levels, respectively.

Twenty-two social groups in total were identified and reclassified into three major categories depending on the services they offer and for ease of analysis. The three categories include production and financial services, supra-community organizations, and social service groups. The supra-community includes institutions whose services, objectives and memberships normally cut across communities or go beyond the borders of particular communities. The description and brief summary of the diverse services they offer are given in Table 3.5 and discussed thereafter in subsequent sub-sections.

It is important to note that the services provided by these groups may not be exclusive to those particular groups or limited to one service type i.e. not specialized. For example, to a small extent, some burials societies may also organize themselves to offer savings and credit services as well as other community mobilization activities. Also, a member is not restricted to one type of association/group but can be a member in more than one type of association like social groups and production groups.

Table 3.5: Associations, groups and services provided

Groups/ Classification	Examples	Services provided
Production and Financial services,	• Savings and credit associations • Rotating credit schemes, • Farmers groups • Women groups	• Provide savings and credit facilities • Exchange of labour, provision of livestock and crop, agro forestry extension services, environmental management activities.
Supra-Community organizations*	• Government programs and structures, • NGO's, • Political party structures, • Education and health groups	• Community mobilization for public good provision • Education, training and senstisation on various needs.
Social service groups	• Burial societies, • Religious, • Drama/choir, • Youth sports clubs	Mutual support activities such as provision of household amenities, hospitality, comforting the bereaved, assisting the disadvantaged, meeting funeral expenses and provide care for the sick.

***Supra-community organisations are organised beyond community programs.**

All the above groups may positively impact on farm and non-farm production and therefore reduce household poverty. These groups/associations normally facilitate cooperation in the direct provision of services, sharing of information, encourage participation in decision making, labour provision, enhance trust building and ameliorate resource constraints among others. The data show that overall membership in associations tends to be skewed towards locally initiated institutions, accounting for more than 81.4 percent of the total membership. This outcome is associated with trust in local organizations built around strong kinship ties of members.

All the groups are ethnically homogenous. More than 93 percent of all groups belong to the same ethnic group. The advantage of homogenous groups is that they tend to be associated with greater trust among members because of stronger kinship ties. The disadvantage however is that such associations

tend to be conservative and enjoy limited success in acquiring and generating new skills and knowledge essential for improvement of household as well as community welfare.

3.4.1 Production and financial services groups

The production and financial services groups are among the most popular categories and account for more than 40 percent of the total membership (Table 3.6). These groups include savings and credit associations, rotating credit schemes, farmers groups as well as many women groups. These groups offer a range of services to members such as provision of savings and credit facilities, exchange of labour, provision of extension services among members, as well as environmental management activities e.g. promotion of energy conservation methods, soil and water conservation technologies among others. Also, these groups provide information about markets, marketing and processing of agricultural products. Being members of such associations therefore provides opportunities to invest in soil conservation and nutrient enhancing technologies, more than in any other groups/categories.

All these services offered have implications on adoption of land management technologies and therefore household welfare. For instance, availability of credit ameliorates credit limitations and other conventional resource constraints such as market access, labour, equipment and therefore increases investment in land conservation. Secondly, credit access may also reduce vulnerability of households to poverty. Thirdly, supply of labour a major activity of this group reduces labour constraints and may lead to use of soil conserving and nutrient enhancing technologies that may be labour intensive such as organic fertiliser and terracing. Labour or resource pooling is a common practise among the farmer groups. Labour pooling mainly targets particular activities such as house building, harvesting, and construction of terraces among others.

Fourthly, these associations and others provide avenues for dissemination of new technologies to the communities. The presence of these institutions can

be utilised for effective extension service delivery. Most of these groups are built on trust among members with the objective of maximizing group interests. This probably explains why more than 75 percent of these groups in this category are locally initiated with more than 95 percent of the members being from the same ethnic group (Table 3.6). Locally initiated institutions tend to be homogeneous. Homogenous associations are built on strong kinship ties because of trust among relatives.

3.4.2 Social service groups

The social service category is the most popular of all, accounting for 51.74 percent of the total membership and covering groups such as burial societies, religious, drama/choir and youth sports clubs. Again these groups offer a wide range of services that are important for household welfare. These services include mutual support activities such as provision of household amenities, hospitality, comforting the bereaved, assisting the disadvantaged, assisting with funeral expenses and provide care for the sick. They basically provide insurance for funeral costs, medical care and hospitality and counseling services where formal insurance markets do not exist. Other services include choir, drama and sports activities for leisure purposes.

These groups also positively impact on household welfare. By sharing the burden of caring for the sick, counseling the bereaved, meeting burial expenses among others reduce emotional pressures and therefore mitigate the negative effects of such social problems and events on individual households. More than 92 percent of the social services groups are locally initiated, with 94 percent of the members being from the same ethnic group.

Table 3.6: Groups/associations in rural Uganda, by membership characteristics

Group type	Membership (freq)	Membership (%)	%ge of group that is local**	Ethnic homogeneity (%)
Production and financial services	696	40.3	75.0	95.1
Supra-Community	137	7.9	42.3	96.3
Social service	893	51.7	92.4	93.9

Source: Author's calculations. ** An association being local means local community initiated.

3.4. 3 Supra-community organizations

This category covers institutions that are largely external (57.7%) to local communities and these institutions/groups include, Non-Governmental organizations (NGO's), government programs and structures, and political party structures. The supra-community institutions are also very important for household productivity and welfare. They provide a range of services that include, community mobilization for public good provision in construction and maintenance of community-based infrastructure e.g. water, roads, electricity, sanitation, education and health facilities. Education, training and senstisation on various household needs such as adult education, domestic hygiene, poverty, nutrition, immunization, family planning, sex education, counseling, and post-natal services. These institutions therefore target improving the health and information for members, and help in the provision of public goods.

The improvement of the health of household members increases their productive labour time by reducing absenteeism caused by sickness. Also, information derived from the educational groups improves the ability of members to take advantage of any opportunity within their community and to further information flow among community members. This category is the least subscribed, with eight percent of membership. One possible explanation is that since majority of these associations are external to the communities, the level of trust in these organizations is low and many do not require broad memberships such as NGO's, extension and government bodies work with selected groups as agents for demonstration and dissemination purposes.

There is a strong presence of NGO's in the country in almost every aspect of livelihood. For instance, the observed success in use of productivity enhancing technologies in Kapchorwa district is partly associated with the strong presence of USAID funded projects such as- Agricultural Productivity Enhancement Program (APEP), and the Rural Savings Promotion Enhancement of Enterprise Development (Rural –Speed). These projects provide training on better farming techniques that increase productivity and have been very influential in securing World Food Program (WFP) long-term maize contracts for the local associations.

3.5 Social capital dimensions by district and income quintiles

Considering the different income groups, there is no clear difference in membership in organisations for the top 80 percent of the (from second up to the fifth quintiles). However, for the bottom 20 percent only 67.6 percent were members of some groups compared to more than 78 percent for all the other groups. One possible explanation is that these are poor landless labourers, not able to afford basic subscription requirements, and end up excluded in all decision making processes.

The poor may have low participation in terms of percentage of members but spend much more time in associational activities compared to the rich. For instance the lowest 20 percent spend an average of 136.9 hours per year compared to 77 hours for the top quintile and 69.9 hours for the fourth quintile. One possible explanation for this outcome could be the low opportunity cost of time for the rural poor. Secondly, the associations/groups and therefore the resultant activities the poor and the rich participate in are different. Poor people are more associated with social groups while the rich tend to be more involved in the production related associations (Table 3.7). Membership to social institutions reduces with an increase in income while membership to production institutions increases with income.

Also as expected districts with strong horizontal networks are more likely to adopt use of soil conservation and nutrient enhancing practices and thus reduce poverty in these districts. For instance, in Kapchorwa and Lira districts the most common associations are those classified as production and financial services while in many other districts, households tend to join the social service associations. Production and financial services groups are expected to be directly related to production and investment in land management activities. This could partly explain the greater use of soil nutrient and conservation practices and thus low poverty levels in Kapchorwa district. Surprisingly, this is not the case for Lira district. The reason for this outcome could be the insecurity in Lira, which has disrupted peoples' livelihoods and may not allow proper functioning of the social institutions.

Table 3.7: Social capital dimensions by income quintiles and districts

Income Quintiles	Membership to Orgs. (%)	Membership to Prodn. and fin. svces (%)	Membership to Supra-Community Orgs. (%)	Membership to Social service Orgs. (%)	Time in Orgs. (Hrs)
Bottom	67.62	32.1	12.4	55.6	136.91
2nd	80.56	42.0	7.2	50.8	85.82
3rd	78.99	36.6	7.1	56.3	87.39
4th	79.30	46.9	3.9	49.3	69.90
Top	85.31	44.3	13.7	42.1	77.05
All	78.13	40.3	7.9	51.7	91.18
Districts					
Masaka	59.33	35.2	21.4	43.4	59.19
Iganga	58.80	53.2	10.7	36.1	64.39
Kapchorwa	84.28	89.1	6.5	4.4	53.55
Soroti	60.00	14.3	0.0	85.7	91.80
Arua	65.89	49.7	16.5	33.8	96.40
Lira	65.52	94.7	0.0	5.3	56.41
Kabale	93.98	24.6	1.3	74.1	130.56
Mbarara	95.53	36.3	3.9	59.8	71.86
All	78.13	40.3	7.9	51.7	91.18

Source: Author's calculations.

Membership to at least one local association is highest in the districts of Kapchorwa, Kabale, and Mbarara districts. However what is important to note is that in districts such as Kabale and Soroti, less than 25 percent belong to production related institutions with the rest belonging to social or supra-community institutions. To the contrary in Kapchorwa district where welfare

levels are higher, more than 89 percent are in production related institutions. The higher membership in production institutions in Kapchorwa could be explained by the strong presence of Kapchorwa Commercial Farmers Association (KACOFA) that organises maize and barley farmers in the district.

3.6 Relationship between social capital and other socio-economic characteristics

Education tends to be associated with higher membership in the production related and supra-community institutions, while the less educated tend to join the social services groups. This could be a sign that the educated are actually taking advantage of the more productive services and opportunities provided by the production and financial services institutions. There are no observed age differences across the different types of institutions a household may join. Value of output per acre, and non-farm income are greatest for those households who are members of supra-community organisations. Possible explanation for the observed relationship is that such organisations of an external origin tend to work with and benefit the local elite and bring little if any assistance to the poorest segments of the community. Alternatively, the organisations actually make their members rich through their supportive mechanisms in credit provision, extension services among others.

Table 3.8 key social economic indicators by social capital groups

Group type	HH - age	Educ (years)	Non-Farm Inc(millions of Ushs per annum)	Value of output per acre (millions of Ushs per annum)	Average no of hrs
Production and financial services	40.8	7.0	0.456	0.531	91.58
Supra-Community	42.7	6.5	0.989	0.787	127.32
Social service	43.2	5.3	0.304	0.358	132.36

Source: Author's calculations

More time is spent in social service activities such as burial, choirs, games and sports as opposed to production related activities such as investment in land management activities. The reasons for this outcome could be that; first, the poorest participate more in social activities because their opportunity cost of time is low. Secondly, the poor sometimes make in-kind contributions by offering their labour time as a way of contributing to associational activities while the rich may pay cash. Lastly, this finding could also be showing the importance the poor attach to these associational activities. The rich may have limited need to join social associations for mutual support in social ceremonies because they can afford to pay for hiring some of these services from commercial providers.

3.7 Relationship between social capital and adoption of land management technologies

There is no major difference in adoption of traditional land management techniques (fallowing, organic and terracing) across the different social capital groups. However, adoption of inorganic fertilizer is much more in production and financial services groups than in the social services groups. A number of reasons may explain this outcome. First, inorganic fertilizer is a purchased input, and therefore requires greater purchasing ability, which is more possible with the other groups other than the social services group. It is also usually imported from outside the rural localities under study.

Table 3.9 Adoption of land management technologies by social capital groups (%age of farmers)

Group type	Fallow (%)	Organic fert (%).	Inorganic fert (%).	Terracing (%)
Production and financial services	30	14.9	4.6	8.4
Supra-Community	26	13.9	5.1	4.3
Social service	27	10.2	0.5	13.3

Source: Author's calculations

Secondly, because of higher awareness, level of education and being more open institutions, production and supra community categories provide more chances of adoption than the social groups. Lastly, the majority of the users are located in Kapchorwa district, where most households are members to social institutions.

3.8 Summary

The discussion in the chapter shows that levels of poverty in different districts may be explained by a number of factors that include; use of soil conservation and nutrient enhancing technologies, differences in household characteristics and agro-climatic conditions, and nature and types of social institutions that are most prevalent. The chapter highlights key interesting observations. First, districts in the bi-modal rainfall zones generally tend to be less poor and more densely populated than their counterparts in the Unimodal zones. Secondly, there is no significant difference in land holdings among the different income quintiles. This outcome is attributed to the structure of the tenure system and variations in population densities across the districts. Third, farmers' awareness of the level of environmental degradation is positively related to adoption.

Regarding the prevalence and characteristics of the social capital associations, a number of interesting outcomes are also observed. First, membership to associations is skewed to locally initiated groups and these associations are ethnically homogeneous as opposed to externally originated. This finding is attributed to relatively higher trust in homogeneous associations. Secondly, more associational time is spent in social groups because of the low opportunity cost of labour for the poorest communities. Third, more educated households tend to join production and financial services groups than the social services institutions. Lastly, well to do households are mostly members of production and financial services groups as opposed to social groups.

To understand the extent to which household and other characteristics highlighted in the above analysis affect household adoption of farming technologies and household welfare, we present multivariate analysis in the next two chapters. Chapter IV that follows discusses the impact of property rights, social capital and poverty on adoption of land management technologies while chapter V there after looks at the determinants of group memberships and the impact this group membership may have on household poverty.

CHAPTER IV

POVERTY, PROPERTY RIGHTS AND LAND MANAGEMENT IN UGANDA

4.1. Introduction

Like in many other developing countries, poverty is one of the major challenges facing policy makers in Uganda. Though poverty was reduced during the 1990's, more recent estimates indicate a national increase in poverty by four percentage points (Appleton and Sewanyana, 2003). About half of the rural households are classified as poor and poverty is more acute for those practising crop farming than among those engaged in non-crop agriculture like livestock and fishing (GOU, 2004b). The fact that, agriculture remains the key economic activity in Uganda (contributing 40% of the GDP, 85% of export earnings and 80% of employment) and the main source of livelihood for the vast majority of the population, especially in the large subsistence segment, indicates the importance of this sector's performance for food security and poverty reduction (GOU, 2004b and NEMA, 2002).

Recent studies show that the major cause of low incomes in the rural areas of Uganda has been stagnating agricultural production (Deininger and Okidi, 2001). One major constraint to improved agricultural productivity in Uganda, as in much of the sub-Saharan African (SSA) countries is land degradation. Exacerbated by poverty, fast growing population, and inadequate tenure security, land degradation poses a threat to national and household food security and the overall welfare of the rural population in Uganda (Nkonya *et al*., 2004).

Poverty acts as a constraining factor on households' ability to invest in mitigating land degradation. Poor households are unable to compete for resources, including high quality and productive land and are hence confined to marginal land that cannot sustain their practices which perpetuate land degradation and further poverty (Kabubo-Mariara, 2003). The poor and food insecure households may contribute to land degradation because they are

unable to keep fallow, make investments in land improvements or use costly external inputs (Reardon *et al*., 2001). Majority of the smallholder farmers in Uganda cannot afford these necessary inputs. Due to credit constraints, inadequate tenure security, as well as weak institutions, poverty can also cause farmers to take a short-term perspective, which limits the incentives for long-term investments in soil conservation (Holden *et al*., 1998; Shiferaw and Holden, 1999; Pender *et al*., 1996).

Surprisingly, despite the level and extent of land degradation and government's effort to promote the use of soil conserving techniques, the rate of adoption of this technology is still very low in Uganda. Technology adoption is still below 30 percent (Nkonya et al., 2004). Thus land degradation and therefore poverty are bound to continue worsening unless immediate intervention policies are put in place. Designing appropriate intervention programs requires proper understanding of the factors that determine the adoption of environmental conservation practices. It is of particular interest to understand the role of poverty in land degradation. Given that government resources to eradicate poverty are limited, targeting specific aspects of poverty that critically limit farmers ability to invest in soil conservation and enhance agricultural productivity would help more rational and effective allocation of such limited resources.

More so, designing appropriate interventions may also require understanding the social institutional frameworks under which such policies to curb land degradation operate. The social institutional structure may facilitate knowledge transfer, greater cooperation, coordination and monitoring of effective public service delivery and ameliorate resource constraints such as credit, markets, and farm equipments all important for adoption and diffusion of agricultural technologies.

In Uganda, studies investigating how social structures that vary from one village to another may affect diffusion and adoption of soil fertility management (SFM) and conservation technologies are non-existent despite existent of a wide heterogeneity of tribal affiliations, formal and informal social

organisations in the country. This is also despite the fact that empirical literature suggests social capital affects adoption and diffusion of land management technologies (Isham, 2000; Reid and Salmen, 2000; Nyangena, 2005; Rogers, 1995). Rogers (1995) argues that the heart of technology diffusion consists of interpersonal network exchanges between individuals who have already adopted an innovation and those influenced to do so. Barbier (2000) also argues that the successes of Machakos[3] in Kenya may not be replicated elsewhere because communities in that area didn't appear to have rigid social structures, which inhibit individuals or sub-groups from collaborating

Earlier attempts to investigate the impact of poverty on adoption of soil conservation practices in Uganda are limited. The only available studies (Pender et al., 2004; Nkonya et al., 2005) though good foundation for further analyses, provide inconclusive results. These studies use a series of indicators such as education, income, natural and physical capital to measure poverty and come up with inconsistent results. By using binomial decision models, the mentioned studies treat adoption choices as being independent of each other and exclude useful economic information contained in the interdependence and simultaneity of adoption decisions (Dorfman, 1996; Wu and Babcock, 1998; Bekele and Drake, 2003).

Applying a multinomial logit model (MNL) to a data set purposefully collected by the World Bank and the International Food Policy Research Institute (IFPRI)[4], this study intends to answer the following questions:

i. What factors determine adoption of SFM and conservation practices by smallholder farmers in Uganda?
ii. How important is the role of land tenure and property rights for SFM and conservation practices?
iii. How does social capital affect SFM and conservation practices?

[3] See also English et al., 1994, Tiffen et al., 1994, on the success story of Machakos district in Kenya.
[4] Am grateful to Kirk Hamilton (World Bank) and Ephraim Nkonya (IFPRI) for facilitating access to this data set.

iv. How important is household poverty in explaining adoption of SFM and conservation, and which particular SFM and conservation technologies are most affected by the level of poverty?

The rest of the chapter is organised as follows; a short survey of relevant theoretical and empirical literature is presented in section two. Section three presents the analytical model used to estimate the determinants of SFM conservation practices in Uganda. Section four discuses the choice of variables as well as the empirical implementation of the model. MNL results are discussed in section five while section six provides the conclusions and policy implications.

4.2. The linkages between poverty, tenure security, social capital and land degradation

4.2.1 Poverty and land degradation

Many theoretical studies have conceptualised the link between rural poverty and the environment as a "downward spiral", where poverty coupled with population growth lead to environmental degradation and thus further enhancing poverty (Scherr, 2000; Mink, 1993, Dasgupta, 1995; Dasgupta and Maler, 1994; and Ekbom and Bojo, 1999). Many of these studies argue that poor farmers are limited to labour intensive production strategies, as they are unable to use external inputs such as fertilisers to support sustainable intensification and are therefore destined to contribute to natural resource degradation (Mink, 1993 and Ekbom and Bojo, 1999).

On the other hand, Reardon and Vosti, (1995) argue that poverty should not be treated as a single concept but should be disaggregated to identify the particular elements that are responsible for the linkage between poverty and environmental degradation. For instance, a household may be poor in spite of the fact it is endowed with some natural resource assets but lacks other complementary assets like human capital or farm physical and financial assets.

Researchers have tried to study factors that reduce poverty and at the same time enhance investment in land management (Barrett *et al*., 2005). These efforts led to an important approach to identifying factors, which will simultaneously improve conservation and poverty outcomes (Vosti and Reardon, 1997; Duraippah, 1998 and Barrett *et al*., 2005).

4.2.2 Land tenure security and investment in SFM and conservation

The literature also tends to suggest that incomplete property rights reinforce the vicious poverty-environment circle (Duraippah, 1998; Ekbom and Bojo 1999 and Scherr, 1999). This line of argument proposes that insecure tenure rights on land and the imperfect functioning of land markets tend to reduce incentives for smaller rural farmers to invest in long-term conservation measures such as planting trees, and soil conservation structures. This line of argument also suggests that, investment in soil conservation measures can only be undertaken when sufficient returns are expected or guaranteed. This is possible, when tenure security is well defined.

Tenure security in this study is defined as the perceived probability or likelihood of loosing ownership of or a part or the whole of ones land without his or her consent (Holden and Yohannes, 2001; Sjaastad and Bromley, 1997). Through investment in conservation, farmers are expected to improve their productivity, leading to increased agricultural output and increased income and therefore their wealth (Holden and Yohannes, 2001). As Dieninger and Feder (1998) put it, by providing incentives for exerting non-observable extra efforts and for use of purchased inputs, tenure security may also have an impact on productivity and farm output even in the short-run.

Several studies have investigated the impact of land rights on investment in conservation activities in developing countries. Surprisingly, despite the well thought theoretical links, results from studies that link tenure security and investment in conservation activities are contradictory and inconclusive. For instance, some studies show that tenure security is not important in

conservation (Migot-Adholla et al., 1991; Place and Hazel, 1993; Brasselle et al., 2002), while others argue that land rights are important for investment in conservation activities (Shiferaw and Holden, 1999b; Deininger and Minten, 1999; Place and Otsuka, 2000; Place and Swallow, 2000; Gabremedhin and Swinton, 2003; Kabubo-Mariara, 2003). These differences are either brought about by differences in measurement of tenure security, or empirical conceptualization of the relationship between investments and tenure rights (Otsuka, 2000; Kabubo-Mariara, 2003).

4.2.3 Social capital and investment in SFM and conservation

Empirical studies show that greater social capital through information sharing, and collective action results in improved adoption and diffusion of technology (Isham, 2000; Reid and Salmen, 2000; Nyangena, 2005). Reid and Salmen (2000) found that social capital (measured in form of trust) is a key determinant of the success of agricultural extension in Mali. By classifying trust into three categories (i.e. trust among farmers, between farmers and extension workers, and extension workers and national institutions), Reid and Salmen (2000) could disaggregate the most important aspects of trust. They however found that all aspects of trust were important in explaining the level and extent of technology adoption. It was also established that social cohesion seen as attendance of social meetings, meetings at churches, cooperation in public goods provision, creates ground for external inputs such as agricultural extension to take root. Women organizations were also found to be consistent diffusers of information and technology (Reid and Salmen, 2000).

In support of the Reid and Salmen (2000) findings, Isham (2000) considered two dimensions of local civil society, the ethnic homogeneity of local group membership, and member participation in decision-making, and their impact on fertilizer adoption in rural Tanzania. He showed that in rural Tanzania, tribal-based social affiliations act as a form of social capital in the adoption decision. A household in a community within which there is greater ethnic

homogeneity and greater member participation in decision-making is more likely to adopt. A study by Fafchamps and Minten (1999) showed that better connected agricultural traders have better information on prices and on credibility of clients, and they enjoy higher sales and profit margins. The authors also showed that the traders in Madagascar rank relationships higher than input prices, output prices and access to credit in terms of their importance to business success.

4.2.4 Other factors that influence investment in SFM and conservation

Ability or capacity of farmers to mobilise resources such as needed labour, capital and other factors for conservation purposes is also important in saving land resources from degradation. Many studies have found a strong association between household assets and environmental problems (Shepard and Soule, 1998; Reardon and Vosti, 1995 and Swinton and Quiroz, 2003).

The characteristics of the natural resource base are also important in explaining the pathway from poverty to environmental degradation. Agricultural landscape for different agro-ecological zones is typically quite distinct, and offers quite different risks of resource degradation, and opportunities and constraints for intensification, diversification and land improvement (Scherr, 2000). In Ethiopia, Bekele and Drake (2003) found that slope of the plot has positive correlation with all types of conservation structures. Pender and Kerr (1998) and Lapar et al. (1999) reported similar results for India and Philippines respectively.

Lack of farmer awareness has been found to be an important constraint to positive adaptation to environmental changes and also a constraint to making appropriate investments on land for conservation (Scherr, 2000). This is a problem where degradation effects are not easily observable by the farmers without the necessary technology, for example to establish soil acidification, micronutrient depletion among others. It could also be a problem where the resource degradation problem is not of a local concern but a negative externality to outsiders e.g. down stream sedimentation.

Following this review of theoretical and empirical literature on the relationship between poverty, land tenure, social capital and land degradation/ management, the study proceeds discussing appropriate analytical approaches used to model the described linkages.

4.3. The analytical framework for modelling farmers decisions to adopt SFM and conservation practices

Many previous studies have modelled the decision to adopt conservation technology as a binary choice process, i.e. whether a farmer adopts a recommended technology or not (Anim, 1997; Kabubo-Mariara, 2003; 2005; Place and Hazel, 1993; Nkonya et al., 2005, Pender et al., 2004; Place and Otsuka, 2002). Using such bivariate models excludes useful economic information contained in the interdependent and simultaneous adoption decisions (Dorfman, 1996; Wu and Babcock, 1998; Bekele and Drake, 2003). It is therefore important to treat adoption of soil conservation measures and adoption of soil nutrient enhancing technologies as multiple-choice decisions simultaneously made.

Alternative approaches that would capture the multivariate nature of farmer's choices or decisions include multinomial probit (MNP) and multinomial logit (MNL) models. These models are important for analysis of land management decisions because land management decisions are usually made jointly. Second, they can be used to evaluate the alternative combinations of management practices, as well as individual practices (Wu and Babcock, 1998). MNP models are however, not commonly used. One of the main obstacles to implementing the MNP model is the difficulty with computing the multivariate normal probabilities for any dimensionality higher than two (Green, 2000).

In the present study, farmers' adoption of land management practices (fallowing, organic and inorganic fertiliser use, terracing and combinations of these practices), are modelled using a MNL model. Multinomial models are

widely used in other branches of economics but not commonly applied to adoption literature. Bekele and Drake (2003) applied the model to examine choice of soil and water conservation practices in Ethiopia and Caswell and Ziberman (1985) applied the model to examine choice of irrigation technologies in California. In the MNL models, each category is compared to the reference category, and in our study, all other technology choices will be compared to the non-adopters category.

Adoption of soil conservation and nutrient enhancing technologies by households can be evaluated on the basis of alternative decision choices, which can easily be linked to utility. According to Greene (2000), the unordered choice model could be motivated by a random utility framework, where the i^{th} household faced with j technology choices, the utility of technology choice j is given by,

$$U_{ij} = \beta_j^{'} X_{ij} + \varepsilon_{ij} \tag{4.1}$$

Where U_{ij} is the utility of household i derived from technology choice j, X_{ij} is a vector of factors that explain the decision made, and $\beta_j^{'}$ is a set of parameters that reflect the impact of changes in X_{ij} on U_{ij}. The disturbance terms ε_{ij} are assumed to be independently and identically distributed. If farmers choose technology j, then U_{ij} is the maximum among all possible utilities. This means that:-

$$U_{ij} > U_{ik}, \forall k \neq j \tag{4.2}$$

Where U_{ik} is the utility to the i^{th} farmer of technology k. Equation (4.2) means that when each technology is thought of as a possible adoption decision, farmers will be expected to choose the technology that maximises their utility given available alternatives (Dorfman, 1996; Zapeda, 1990). The choice of j depends on X_{ij}, which includes aspects specific to the household and plot among other factors. Following Green (2000), If Y_i is a random variable that indicates the choice made, then the multinomial logit form of the multiple choice problem is given by:

$$\Pr ob(Y_i = j) = \frac{e^{\beta_j' X_{ij}}}{\sum_{j=1}^{j} e^{\beta_j' X_{ij}}}, j = 0, 1, 2.....j \quad (4.3)$$

Estimating equation (4.3) provides a set of probabilities for *j*+1 technology choices for a decision maker with characteristics X_{ij}. The equation can be normalized by assuming that $\beta_0 = 0$, in which case the probabilities can be estimated as:

$$\Pr ob(Y_i = j) = \frac{e^{\beta_j' X_{ij}}}{1 + \sum_{K=1}^{j} e^{\beta_j' Z_{ij}}} \text{ and:} \quad (4.4)$$

$$Pr ob(Y_i = 0) = \frac{1}{1 + \sum_{j=1}^{j} e^{\beta_j' X_{ij}}} \quad (4.5)$$

Normalizing on any other probabilities yields the following log-odds ratio

$$\ln\left[\frac{p_{ij}}{p_{ik}}\right] = x_i'(\beta_j - \beta_k) \quad (4.6)$$

In this case, the dependent variable is the log of one alternative relative to the base/reference alternative.

The coefficients in a multinomial logit model are difficult to interpret, so the marginal effects of the explanatory variables on the choice of alternative management strategies are usually derived as (Green, 2000):

$$m_j = \frac{\partial P_j}{\partial x_i} = P_j\left[\beta_j - \sum_{k=0}^{j} P_k \beta_k\right] = P_j\left[\beta_j - \overline{\beta}\right] \quad (4.7)$$

The sign of these marginal effects may not be the same as the sign of respective coefficients as they depend on the sign and magnitude of all other coefficients. The marginal probabilities measure the expected change in the probability of a particular choice being selected with respect to a unit change in an independent variable (Long, 1997; Green, 2000). Also important to note is that in a multinomial logit model, the marginal probabilities resulting from a

unit change in an independent variable must sum to zero, since the expected increases in marginal probabilities for certain options induces a decrease for the other options within a set.

4.4. Empirical Methods

4.4.1 Choice of explanatory variables and model implementation

The study area and the characteristics of the different districts covered by this study are discussed in chapter three. In this section, variables chosen for inclusion in the MNL model as well as the empirical implementation of the model are discussed.

4.4.1.1 Controlling for the effect of poverty

This study used the level of per-capita household expenditure to construct appropriate measures of poverty. This is one of the most widely used approaches to measure poverty (Geda et al., 2001; Mukherjee and Benson, 2003). To compute this variable the study uses data from the 2002 - Uganda National Household Survey (UNHS). Household expenditure in the UNHS is made up of four components: (i) total food consumption expenditure whether purchased or from home production, (ii) total non-food expenditure on durable (iii) total non-food expenditure on non-durable goods, and (iv) non-consumption expenditure such as taxes. The Per-capita household expenditure is expressed in real terms normalised using 1989 as the base year.

Using the generated per-capita household expenditure a poverty dummy variable (poor=1, non-poor=0) was generated. Farming households were thus classified into two categories (poor/non-poor) using the standard national poverty lines [calculated based on the people's food calories requirements adjusted by a mark-up for non-food requirements (Appleton, 2003)]. In Uganda, different poverty lines are used for different regions to take into account differences in staple foods consumed, tastes and consumption preferences, as well as price differences (Appleton, 2003).

The literature postulates that poverty and adoption of various land management technologies are reciprocally interrelated. On one hand, poverty determines the level of adoption of particular technologies. At the same time however, level of adoption may have implications on land productivity and therefore on poverty. Introducing poverty on the right hand side therefore introduces an endogeneity problem in the model. This occurs when the regressors are correlated with the error term.

There is need for an approach that corrects for the possible endogeneity problem, because ignoring it can lead to biased coefficient estimates and inference. Treatment of endogeneity in non-linear models cannot be pursued using the Instrumental variables approach, as commonly used in linear models. The literature however suggests a two-stage probit least-squares (2SPLS). Two-stage probit and Logit models have been widely used to correct for endogeneity in the literature (Lee et al., 1980; Hassan, 1996). A description of this approach and how it was used in this study is presented in section 4.4.2.

4.4.1.2 Controlling for social capital impacts

In this study, one critical component of social capital, namely, participation in agrarian associations such as production, supra community and social groups is used. Membership in agrarian associations has been widely used in the literature to measure social capital (Narayan and Pritchett, 1999; Alesina and La Ferrara, 2000; Grootaert, 1999; Grootaert et al., 1999; Putnam, 1993b) Putnam (1993b) argues that participation in social groups may lead to the transmission of knowledge and may increase aggregate human capital and the development of trust which improves the functioning of markets.

Following Hadad and Malucio (2000; 2003) the proxy measure of membership to a group is redefined to distinguish among the different types of groups to enable the study of how group membership affects adoption of SFM and

conservation technology. Since different social organisations play different roles in the lives of rural communities, it is important to establish which particular institutions may be more related to adoption of agricultural technologies and which particular technology. To achieve this objective, a dummy variable (membership to production institutions) is used in the adoption model. Chapter three of this study provides a clear exposition of the different categorisation of these associations as well as their functions and services.

4.4.1.3 Controlling for the impacts of land tenure

It is hypothesized that insecure land tenure provides a disincentive for farmers to invest in land improvements and conservation and therefore low agricultural productivity. In this study, land tenure is measured by the right to bequeath land to next generations is used as the control for the effect of land tenure. Bequeath is an indicator of long-term tenure security.

4.4.1.4 Other Explanatory variables

Choice among the different technologies modelled in this chapter depends on household, institutional as well as plot level characteristics. Examination of the literature focused on adoption of soil conservation and fertility enhancing technologies in Africa suggests that choices among the different technologies depend on household attributes (level of poverty and asset endowments, access to information, household size, age and education of household head), institutional factors (land tenure, social capital) and plot level characteristics (state of soil nutrients, slope, farm size) (Kabubo-Mariara, 2004; 2005; Shiferaw and Holden, 1998; Nkonya et al., 2005; Pender et al., 2004). The set of regressors that were chosen, their definition, measurement, as well as the expected direction of influence on adoption are given in Table 4.1.

Table 4.1: Definition of variables used in the empirical analysis

Variable	Definition	Values/measure	Expected sign
Sex	Sex of household head	1=Male and 0=Female	+/-
Bequeath	Right to bequeath land to next generations	1=yes and 0=no	+
Dist Res	Distance from plot to residence	Kilometres	-
Dist MKT	Distance from plot to nearest mkt	Kilometres	-
Nutrient prob.	Perceived nutrient deterioration of plot	1 if observed deterioration and 0 if not	+
Non-farm inc.	Non-farm income	Uganda shillings	+
Agric extension	Access to agricultural extension information	Dummy (1=if household had access to an extension agent in 2002, 0=if not)	+
Age of hh head	Age of household head	Number of years	+/-
Educ of hh head	Education for household head	Number of years in school	+
Hh size	Size of household	Number of household members	+
Livestock	Livestock Ownership in Tropical Livestock Units (TLU)	Average TLU for common livestock in Uganda is cow = 0.9, Oxen = 1.5, sheep or goat = 0.2, calf = 0.25	+
Number of parc	Number of parcels a household owns	Number	+
Agro-climate	Agro-ecological zones based on rainfall patterns	Agro-ecological zones, (Dummy variable, Bi-modal rainfall =1 and Uni-modal rainfall=0)	+/-
Memb. to pdn org	Membership in production associations	1=yes and 0=no	+

4.4.2 Econometric specification of the MNL model for land management decisions

A Multinomial model for land management practices was estimated using data collected from all the eight districts discussed in chapter three. The choice set (response variable) for the MNL model included six land management technologies: (i) fallowing, (ii) organic fertiliser (iii) inorganic fertiliser, (iv) terracing, (v) combination of the different soil fertility management (SFM) and terracing and (vi) continuous cropping without any land management (no adoption). Several combinations of the different types of soil fertility management were not included in the analysis because of the small number of plots where such combinations were used. For instance, less than 2 percent of all the plots covered used combinations between fallowing and organic fertilizer, fallowing and inorganic, organic and inorganic, and the inorganic and terracing.

The terracing option included represents the use of stones, bench, fanya juu, and fanya chini types of terraces. Organic fertilizer reflects use of mulching, animal manure, household refuse, biomass transfer and cover crop. Inorganic fertiliser use covered the N fertiliser (urea, ammonium nitrate), P fertiliser (SSP, DAP and TSP) and Composite fertilisers (NPK). These technologies are chosen because they are commonly used in Uganda as land management practices or are being promoted for use through the country's extension system as seen in Chapter three.

Before empirical estimation of the MNL model, the independent variables were scrutinised for possible correlations since multi-colinearity is a common problem with such data sets. A number of variables including distance to nearest all weather road and distance to nearest seasonal road both strongly correlated with distance to markets, main source of income correlated with non-farm income, ethnic dominance and origin of institution (whether local or foreign) correlated with membership were therefore not included in the model.

As noted earlier, a two-stage econometric process was used to correct for endogeneity caused by the endogenous regressors being correlated with the error term. In the first stage, the poverty model was estimated using the probit[5] maximum likelihood procedure. In the second stage, fitted values of the endogenous variable (poverty) are computed using the first stage parameter estimates and used as regressors (instruments) in the MNL adoption model to estimate the determinants of technology adoption. Poverty is expected to reduce the probability of adopting all the different SFM and conservation technologies.

Another challenge was the problem of heteroscedasticity, common in cross section data analysis. In this study, White's heteroscedasticity consistent covariance matrix (HCCM) was used to correct for heteroscedasticity of an unknown form (White, 1980). By including the option "robust" on the MNL model, the study specifies the Huber-White sandwich estimator to correct for heteroscedasticity. Long and Ervin (2000) argue that the HCCM provides a consistent estimator of the covariance matrix of the slope coefficients in presence of heteroscedasticity and can be used to avoid its adverse effects on hypothesis testing even when nothing is known about the form of heteroscedasticity.

MNL models are very commonly used for estimation of polychotomous choice models because of its relative ease of estimates and interpretation. However, the MNL imposes a rather restrictive assumption of "Irrelevance of independent alternatives (IIA)" assumption. IIA assumption implies that the ratio of the utility levels between two choices say organic fertiliser and Inorganic fertiliser remains the same irrespective of the number of choices available. The Hausman test (Hausman and McFadden, 1984) was used to check whether the IIA assumption is violated. The test results show that we cannot reject the null hypothesis of

[5] Logit estimation is also appropriate for analysing binary response data. There is therefore no apriori reason to prefer probit over logit estimation (Green, 2000;Gujarati, 1995)

independence, suggesting use of MNL is appropriate. STATA software (STATAcorp, 2005) was used to implement the econometric analyses.

4.5. Results of the multinomial analyses of determinants of adoption of land improvement and conservation practices

This section presents results of the econometric analyses of the linkage between poverty, property rights social capital and land management practices of farmers in Uganda. Table 4.2, shows the estimated marginal effects and P-levels derived from the MNL model for adoption of land management technologies while appendix 5 provides the estimated MNL coefficients.

Most of the explanatory variables are statistically significant at 10% or less and have the expected signs except for a few surprise outcomes discussed below. Generally the results show that poverty hinders adoption of SFM and conservation technologies. Poverty is negatively related with adoption of organic ($P<0.01$), inorganic ($P<0.01$) fertilizer use, terracing and a combination of terracing and other soil fertility management practices. In fact the magnitudes of the estimated marginal effects of poverty indicate that poverty has a very strong influence on the adoption of these practices compared to other factors. Poverty is also found to positively influence the probability of non-adoption of any technology.

The negative association between poverty and technology adoption suggests that poverty is a key constraint to adoption of land management technologies, which supports earlier findings in related studies (Kabubo-Mariara, 2004; Shiferaw and Holden, 1999b; 2001; Li et al., 1998). However, it could also be a reflection of poor targeting technologies. For instance NAADS has been blamed for targeting the rich and neglecting the poor. From a policy perspective, this finding suggests that government efforts to reduce poverty would improve adoption of conservation and soil fertility management practices. More

importantly, technology targeted to the poor through the agricultural extension programs in the country could be important to improve technology adoption.

The results also suggest a positive relationship between adoption of fallowing ($P<0.05$) and poverty. This may be considered a rather surprising result, because it suggests that the poor with lower asset levels may adopt fallowing more than the rich, who are expected to have more land. However, two reasons may explain this finding. First, descriptive statistics in chapter three showed that there is no significant difference in farm size among the different income quintiles. In fact the chapter shows further that the poor districts such as Lira and Soroti have on average larger farm size than better-off districts. This finding is attributed to the nature of land tenure and distribution of the population in the country. The descriptive statistics also show that the poor districts of the north have low population density, suggesting more land is available for these poor households. In addition, the land tenure in these districts such as Soroti and Lira is largely customary for communal use. As highlighted earlier, under this tenure regime, in Uganda, land is divided among clans which in turn divide it among the households irrespective of the level of income. Second, the poor usually have limited choices given the cost implications of the alternative choices available.

In this model we also use the right to bequeath land to future generation to capture the land tenure impact. The right to bequeath is seen as an indicator of long-term tenure security and as a result encourages the farmer to have longer planning horizons. As expected, we find long-term tenure security to positively influence adoption of fallowing ($P<0.05$), organic fertilizer application ($P<0.01$), terracing and a combination of terracing and other SFM and generally reduces the probability of non-adoption ($P<0.01$). Our regression results support those in earlier related studies (Shiferaw and Holden, 1999b; Place and Otsuka, 2002; Place and Otsuka, 2000; Place and Swallow, 2000; Gebremedhin and Swinton, 2003; Kabubo-Mariara, 2004), which find tenure rights to be important for investment in conservation activities. The policy implication of this finding is that

policies that facilitate and encourage tenure security such as easing the land registration and titling processes in order to ensure long-term tenure security can significantly increase the probability of adoption and provides incentives for investment in conservation activities.

A surprise result however is the negative relationship between land tenure and adoption of inorganic fertilizer. Suggesting that farmers prefer to use inorganic fertilizer on less secure land to maximize short-term benefits and reserve other inputs for owned plots, with long-term security. This is in support of earlier findings by Gavian and Ehui (1999) in Ethiopia, who found that small holder farmers tend to use inorganic fertilizer on less secure lands.

Membership in production associations were found to be positively related to the likelihood of adopting fallowing ($P<0.1$), terracing ($P<0.1$), inorganic fertilizer and generally reducing the probability of non adoption of all technologies ($P<0.05$). These outcomes are expected because of information dissemination among group members, trust and cooperative action among the members that production related institutions promote. These findings suggest that investment and promotion of social capital institutions such as production associations is of importance to adoption of SFM and conservation technologies. Two policy implications of these outcomes are clear. First, development projects should not be designed to deal with all communities uniformly, but be adapted to different levels of existing social institutions and norms. A study by Purcell and Anderson (1997) concluded that designers of extension programs need to place emphasis on pre-project analysis and project preparation in order to asses and identify farmer circumstances, including formal and informal institutional constraints.

Second, extension workers need to understand the social and institutional fabric in their areas of work. They should promote and exploit the existing social infrastructure for dissemination of information about new technologies, and encourage cooperative action in areas of resource pooling such as labour

sharing, savings among others. For example, the extension system in Uganda for information sharing has been mainly based on the training and visits by extension agents on scheduled meetings. It is therefore argued that such visits and training should be organized with already well-established local organizations because of the already established trust inherent in these institutions but also this arrangement would reduce project costs of mobilization. As discussed in chapter 2, the new NAADS program has tried to use a similar approach but has had serious implementation problems.

One surprising result however was the negative relationship between membership in production associations and the adoption of organic fertilizer use. Production institutions comprise of savings and credit associations, rotating credit schemes, farmers groups and women groups. Of these categories, membership to the first two constitutes 60 percent of the total membership. This could therefore suggest availability of credit that is used to purchase SFM alternatives instead of labour intensive organic fertilizer. Secondly in the districts of Arua and Kapchorwa where inorganic fertilizer is mostly used, the production associations such as farmers groups are directly involved in procurement and distribution of inorganic fertilizer to the members, and therefore promoting use of purchased inputs and hence the less need for using organic sources.

Farmers' access to information though positively related with most of the practices, the results from the MNL model show that agricultural extension doesn't significantly affect adoption of most of the technologies except use of inorganic fertilizer ($P<0.05$). Prior adoption studies in Uganda (Nkonya et al., 2005; Pender et al., 2004) have come up with similar findings. Two reasons may explain this outcome. First, the extension system in Uganda has been packaged to promote use of inorganic fertilizer in an effort to intensify agricultural production. Secondly, the weak relationship between extension and adoption decisions might be attributed to the inadequate and some times complete absence of extension services. Only 28 percent of the sampled households had

had a single visit by an extension agent for a period of one year. The policy implication of this outcome is that there is need to revitalize the extension services and open it to support use of other traditional SFM and conservation technologies that are more readily available to the farmers.

Households that are endowed with family labour are expected to use labour intensive management practices. This explains the positive and significant relationship between household size and adoption of organic fertilizer ($P<0.01$) and terracing, which are labour intensive. The negative relationship of household size with fallowing ($P<0.1$) could be attributed to the fact that larger households tend to hold smaller farms and hence can not afford to fallow but use other alternative SFM practices. Farmers' age was significantly and positively related to adoption of fallowing ($P<0.05$), but negatively related to adoption of inorganic fertilizer use ($P<0.01$). One possible reason that could explain this outcome is that older farmers are more risk averse and therefore resistant to change to newer technologies since they are more used to traditional management systems.

In fact non-farm income was found to be positively related to adoption of fallowing ($P<0.01$) but negatively related to adoption of inorganic fertilizer ($P<0.05$), terracing ($P<0.01$) a combination of terracing and other SFM ($P<0.05$) and organic fertilizer. This is another surprising result since non-farm income is expected to bring the much-needed cash for the purchase of external inputs. Earlier analyses (Nkonya et al., 2005) have come up with similar results. A number of reasons could explain this outcome. First, agriculture is generally not profitable in Uganda (Nkonya, 2002) and this discourages investments in SFM and conservation. Secondly, non-farm activities are generally more profitable and are in many cases full time activities and sometimes located away from the farm and taking away the much needed labour in the agricultural sector. The non-farm activities eventually become the key source of family livelihood. As Haggblade et al. (1989) argue initially farmers integrate non-farm activities with farming

activities on a seasonal or part time basis. With time, returns from non-farm activities are invested in farming activities but eventually because of increases in demand for non-farm goods, those involved in non-farm activities break away from farming to become involved in non-farm activities on a full time basis.

Agro-climatic zones stand out as an important factor that could explain differential use of SFM and conservation technologies in the study areas. For instance, the likelihood of using fallowing and inorganic fertilizer in the bi-modal agro-climatic zones is 27.63 and 9.69 percent, respectively, lower than in Unimodal agro-climatic zones. As noted in chapter three, most districts in the Unimodal zones are sparsely populated and therefore fallowing is more possible than in the densely populated districts in the bi-modal zones. The likelihood of using inorganic fertilizer is also higher in the Unimodal agro-climatic zones because of organized input supply for maize/barley and tobacco farmers in Kapchorwa and Arua districts, respectively, and relatively better extension services in Soroti district. However, the likelihood of using organic fertilizer and terracing is higher in the densely populated bi-modal agro-climatic zones, because of availability of family labour and ability to pay for hired labour, since these are labour intensive technologies.

Results show that the number of parcels a household owns is significantly and positively related to fallowing ($P<0.01$), inorganic fertilizer ($P<0.01$), terracing ($P<0.01$) and a combination of SFM and terracing ($P<0.01$). In general, having more parcels reduces the probability of non-adoption ($P<0.01$). Having more plots is an indicator of a larger farm size allowing the farmer to practice terracing, and fallowing quite easily. One biggest challenge in the densely populated highland districts is that terraces are occupying large productive space hence leading to their destruction. The results however also show a negative relationship between number of plots and organic fertilizer use. This is again as expected because use of bulky manure on many plots involves high costs of

transporting and distribution, hence reducing the likelihood of adopting the technology.

The results show that farmers tend to adopt organic fertilizer (P<0.01) on plots closer to their homesteads while adopting fallowing (P<0.01), inorganic fertilizer (P<0.01), terracing (P<0.05) and a combination of terracing and other SFM practices (P<0.01) in far off plots. Overall, longer distances from homesteads to plots increase the probability of non-adoption (P<0.01). The reason for this outcome is that organic fertilizer use is a labour intensive activity. The greater the distance therefore the greater the labour needs and other associated transaction costs for transporting and distributing the bulky manure. Farmers therefore choose to use less costly technologies such as fallowing and inorganic fertilizer in far off plots and more labour intensive organic fertilizer in plots close to their homesteads.

As expected, distance to markets was found to reduce the probability of adopting inorganic fertilizer (P<0.01) but increases the probability of using fallow (P<0.01) and a combination of terracing and other SFM technologies (P<0.01). Far off markets imply high costs of transactions for both inputs and output goods. The high costs coupled with the level of poverty, therefore reduces the probability of using marketed inputs like inorganic fertilizer while increasing use of traditional technologies such as fallowing. From the policy perspective, these findings suggest that road infrastructure development would reduce non-adoption of marketed inputs.

Table 4.2: Marginal effect for the MNL for adoption of Land Management technologies

Variable	Fallow		Organic Fert		Inorganic Fert		Terracing		Terracing+SFM		Non-adopters	
	ME	P-Level	ME	P-Level	ME	P-Level	ME	P-Level	ME	P-Level	ME	P-Level
Sex	0.0916***	0.0000	0.0114	0.3560	-0.0166*	0.0530	0.0232***	0.0010	0.0051	0.5930	-0.1146***	0.0000
Bequeath	0.0447**	0.0470	0.0417***	0.0010	-0.0111*	0.0590	0.0038	0.5090	0.0010	0.9310	-0.0800***	0.0030
Dist Res	0.0110***	0.0040	-0.0407***	0.0000	0.0015***	0.0000	0.0011**	0.0280	0.0027***	0.0040	0.0244***	0.0020
Dist MKT	0.0094***	0.0070	0.0002	0.9350	-0.0044***	0.0000	0.0002	0.7840	0.0038***	0.0000	-0.0092**	0.0200
Nutrient prob.	0.0304	0.1060	0.0095	0.3430	-0.0046	0.2260	-0.0034	0.5270	-0.0110	0.2380	-0.0210	0.3350
Non-farm inc.	0.0588***	0.0000	-0.0088	0.1400	-0.0058**	0.0240	-0.0423***	0.0000	-0.0347**	0.0220	0.0329*	0.0660
Agric extension	0.0061	0.7840	0.0105	0.3800	0.0157**	0.0150	0.0110	0.1240	-0.0160	0.1510	-0.0274	0.2920
Age of hh head	0.0020**	0.0140	-0.0008*	0.0760	-0.0006***	0.0080	-0.0003	0.2010	0.0004	0.4740	-0.0008	0.4170
Educ of hh head	0.0004	0.9080	0.0007	0.6700	-0.0006	0.2800	-0.0014	0.1250	0.0013	0.4750	-0.0004	0.9190
Hh size	-0.0116***	0.0090	0.0072***	0.0040	0.0052***	0.0000	0.0010	0.4260	-0.0013	0.6560	-0.0006	0.9190
Poverty	0.2375***	0.0060	-0.1525***	0.0010	-0.0815***	0.0000	-0.0025	0.9030	-0.0657	0.1470	0.0646	0.5280
Livestock	-0.0007	0.7560	-0.0008	0.4910	-0.0002	0.7160	0.0007**	0.0460	-0.0007	0.3780	0.0017	0.4600
Number of parc.	0.0207***	0.0000	-0.0072***	0.0010	0.0018***	0.0010	0.0034***	0.0000	0.0064***	0.0000	-0.0251***	0.0000
Agro-climate	-0.2763***	0.0000	0.0446***	0.0010	-0.0969***	0.0000	0.0245***	0.0000	-0.0078	0.6620	0.3118***	0.0000
Memb to pdn org	0.0432*	0.0560	-0.0050	0.6550	0.0089	0.1030	0.0117*	0.0860	-0.0069	0.4820	-0.0519**	0.0450

SFM = Soil Fertility Management; Non-adopters are used as the base category. *, **, and *** represent the level of significance at 10, 5 and 1 percent respectively

Ownership of livestock assets has limited impact on most land management technologies. Ownership of livestock is only positively and significantly related to adoption of terracing ($P<0.01$). This could be explained by the fact that livestock is considered a measure of wealth that increases the availability of capital and makes investment in conservation feasible. Surprisingly we do not find a positive and significant impact of livestock ownership and adoption of organic fertilizer. Possible explanations for the non-significance of the livestock ownership variable on adoption of organic fertilizer is that the measure of tropical livestock unit used in the study captures all types of animals including goats, sheep, calf, cows, ox etc. In areas where households keep cattle, which generate significant amount of animal manure, are not seriously involved in crop agriculture except for small subsistence gardens. Some are nomads and livestock is their major source of livelihood. In other areas where sheep and goats and other small animals may be kept, as much as they may be involved in crop agriculture, the animals generate limited manure.

4.6 Conclusions and policy implications

This chapter was concerned with the determinants of adoption of land management technologies, in particular, the impact of poverty, social capital and land tenure on adoption of SFM and conservation activities. In order to capture the interdependence and joint nature of adoption decisions, a multinomial logit analyses was performed generating findings that suggest the following,

i) Poverty increases the probability of non-adoption in general and particularly reduces the probability of adopting organic and inorganic fertilizers and terracing, mainly because the poor have limited access to cash and markets and lower land and livestock assets. This finding suggests that government programs to reduce poverty would go a long way in promoting the use of SFM and conservation practices. In the following chapter, the study explores more the determinants of poverty

and more importantly the role of social capital in explaining poverty in Uganda.

ii) Land tenure security is positively correlated with adoption of fallowing and organic fertilizer use only but generally reducing the probability of non-adoption of land management technologies. However it was found not to significantly influence adoption of soil inorganic fertilizer use and terracing. These results also suggest that programs that enhance tenure security such as land registration would encourage adoption of most land management practices.

iii) We also find that participation in social institutions generally tends to increase the probability of adopting most land management practices. This finding is also very important especially in Uganda where social capital issues are not well researched and incorporated in government policy papers. Investment in social capital is therefore of paramount importance for adoption of land management technologies. The policy implication of these results is that extension workers should understand the social and institutional fabric in the places of work. Extension agents themselves need to be trained to enhance local context so that the villagers become more receptive to new agricultural techniques and methods. For policy purposes therefore, development projects should not be designed so that they deal with all communities uniformly, but be adapted to different levels of existing social institutions and norms. The role of social capital on household welfare will therefore be the major concern for chapter five of this thesis.

CHAPTER V

SOCIAL CAPITAL AND POVERTY IN UGANDA

5. 1 Introduction

Like in most sub-Saharan African countries, poverty in Uganda is pervasive. Using the Household survey data-2002, Appleton and Sewanyana (2003) show that the proportion of the population whose incomes fall below the poverty line is 38 percent. Poverty is more rampant in the rural areas where 41 percent of the rural residents are below the poverty line as opposed to 12 percent of the urban residents. This outcome is despite using poverty lines allowing higher food prices and non-food requirements in the urban areas. Apart from the rural-urban differences, poverty also varies across regions, with the north being the most poor compared to other regions.

Also important to note is the fact that poverty is highest for those households whose head works in the agricultural sector. For instance poverty among households headed by crop farmers increased from 39 to 50 percent between 1999 and 2002 while poverty dropped from 47 to 38 percent for those households whose head works in non-crop agricultural sector (Livestock and Fishing) for the same period of time (Appleton and Sewanyana, 2003). Smallholder farmers dominate the agricultural sector in Uganda, and the sector continues to employ more than 80 percent of the population, earning 85 percent of the foreign exchange and contributing 40 percent of the GDP. Given the large rural-urban gap in poverty levels and the importance of agriculture to the entire economy and to the rural economy in particular, understanding the crucial factors that influence poverty and income inequality in rural communities is crucial for development policy making.

Poverty has devastating impacts on rural households. First, acts as a constraint to investment in land management technologies to curtail land degradation (Holden et al., 1998; Shiferaw and Holden, 1999). Chapter four of this study also

shows that poverty generally reduces adoption of soil conservation technologies. More so, because of poverty, rural households are not able to compete for productive resources such as high quality and productive land and are hence confined to marginal lands that cannot sustain their agricultural practices, which perpetuates land degradation and further poverty.

To avoid these devastating effects of poverty, identification of the determinants of poverty and the design of government policies to address the poverty problem have been identified as priorities by the government of Uganda since the mid 1990's (GOU, 1997). The government commitment to alleviate poverty has led to the culmination of the program for the modernization of agriculture (PMA) (GOU, 2000) and poverty eradication action plan (PEAP) (GOU, 1997, 2000b, 2004b). An important component of the Uganda anti-poverty policies focus on the provision of key services such as roads, education and agricultural extension among others. Equally important, however, is the social institutional framework through which the provision of such services may yield greatest benefits to society, but has however attracted minimum attention.

Earlier studies in Uganda attempted to explain poverty emphasising on the differences in financial, physical and human capital endowments and paying less attention to the role of social capital (Appleton, 1999; 2001; Okwi et al., 2000; UPPAP, 2000). However, since the seminal paper by Putnam (1993b) on the role of social capital in explaining why the level of income in the north was higher than that in the south of Italy, there has been growing interest in understanding the role of social capital in economic development and on household welfare. Putnam's findings suggest that the regions in Italy, in which the population had a greater degree of horizontal connections (north) as opposed to vertical connections (south), had more efficient governments.

Recent analyses have demonstrated that ownership of social capital by households has a positive and significant effect on household per capita

expenditure and/or incomes (Narayan and Pritchett, 1999; Grootaert, 1999; Grootaert et al., 1999; Tiepoh and Reimer, 2004; Whitely, 2000 and Maluccio et al., 2000). In many cases, the social capital impact was as strong as and sometimes stronger than human capital impact. For instance Narayan and Pritchett (1999) in Tanzania find the impact to be 4-10 times stronger, Grootaert (1999) find the impact twice as much in Indonesia, while Whitely (2000) find the impact as strong as that of human capital.

The mechanisms through which social capital embedded in social networks, trust and norms, is said to reduce poverty can be summarised as; i) it facilitates transmission of knowledge about technology and markets, reducing market failures in information and therefore reducing transactions costs (costs of obtaining information about technology, market, creditworthiness of contract parties among others). ii) Reducing problems of free riding and thereby facilitating cooperative action, iii) coordination and monitoring effective public services delivery, iv) ameliorating other conventional resource constraints such as market access or credit limitations and thus reduce vulnerability of households to poverty.

In Uganda, a diverse set of local formal and informal institutions with diverse objectives exist. These institutions include, community based organisations (CBO's), local village associations, elders associations, mutual self-help groups, churches, non-governmental organisations (NGOs), government structures such as local councils, cooperatives among others. These institutions have a diverse set of short-term and long-term objectives covering, monitoring and provision of public services, establishment of income earning activities, mutual assistance, and social support. Such institutions may therefore have a significant impact on poverty reduction. The types, objectives and structures differ across institutions, and different regions of the country, because of the ethnic and religious diversity of the population.

Verifying empirically the impact of social capital on household poverty is a much more difficult task than what may appear at first sight. The reason is that there is a causality problem, with some literature suggesting that the causality actually runs from household poverty to social capital. For instance, when joining associations involves actual cash contributions, poor households will choose those associations that are highly beneficial to them and/or those that do not require any contributions. Secondly, if social capital is considered a consumption good like in non-mandatory social groups pursuing leisure activities, such leisure activities are considered luxury. Demand for leisure therefore is expected to increase with income. This leads to a reverse causation from welfare to social capital. Before drawing any conclusions about the poverty-social capital relationship, it is therefore important to follow a methodology that effectively controls for the endogeneity of social capital.

In the literature the impacts of social capital on measures of well-being are well established. On the other hand, economic literature on social capital formation is limited. Alesina and La Ferrara (2000) in USA and Christoforou (2004) in Europe and Hedad and Malucio (2003) in South Africa show that group participation as a measure of social capital is determined by a host of factors such as education, homogeneity of communities, trust and other household characteristics. Studies of this nature are important to generate policies in support of social institutional building and thus poverty reduction. Research towards a causal understanding of the processes through which social capital is formed would therefore be a great contribution to policy making in Uganda

However, the empirical literature on determinants of social capital and that on impact of social capital on economic outcomes are not properly linked. Using a purposefully collected rural data set in Uganda, this study intends to contribute to an understanding of the causal relationship between social capital as measured by group participation and household level poverty. Specifically we examine;

i) The importance of social capital in explaining the level of household poverty in Uganda.

ii) The importance of poverty and other determinants in the decision to participate in agrarian groups.

Following this introduction, the rest of the chapter is organised as follows; in the next section, a conceptual framework linking poverty and social capital is discussed. Section three discuses the analytical framework to be used while section four discuses the empirical model used to estimate the determinants of poverty and social capital formation (group participation). Data sets, and variables used in the analysis are discussed in section five and econometric results are presented and discussed in section six. Section seven on the other hand provides the conclusions and policy implications.

5.2 Conceptualising the link between social capital and poverty

The proper conceptualization of social capital remains illusive without a generally acceptable definition of social capital. Table 5.1 presents key definitions commonly encountered in the literature as summarized by Hedad and Maluccio, (2003). More recently, Dasgupta (2005) argues that social capital means interpersonal networks and nothing more. Apparently, all the definitions highlighted tend to suggest that individual social interactions are at the core of social capital. Also clear from these definitions is the fact that social capital generates externalities and that the mechanism that derives social capital has to do with information transmission, establishment of trust and development of norms of collaboration.

To understand the channels through which social capital operates, we follow a framework suggested by Collier (2002). Collier classifies social capital based on economically beneficial results from three types of externalities it generates. First, social capital facilitates the transmission of knowledge about the behaviour of others, reducing the problem of opportunism through repeat transactions that

establish trustworthiness and reputations. Secondly, it facilitates the transmission of knowledge about technology and markets, reducing market failures in information. Lastly, by relying on norms and rules, social capital reduces the problem of free riding, thereby facilitating cooperative action. We therefore expound on these channels in our discussion taking into consideration the literature on the subject.

Table 5.1: Common definitions of social capital in the literature

Source	Proposed definition of Social Capital
Barr (2000)	Net work of relationships between the agents within an economy
Coleman (1990)	Authority relations, relations of trust, and consensual allocations of rights establish norms
Collier (1998)	Social capital is first a subset of the process which generates externalities namely those which are generated by social interaction, including only those which either are themselves durable or the effects of which are durable
Fukuyama (2000)	An instantiated informal norm that promotes cooperation between two or more individuals
Glaeser, Laibson, and Sacerdote (2000)	Individual social capital as a persons social characteristics-including social skills, charisma, and the size of his rolodex-which enable him to reap market and non-market returns from interactions with others
Knack and Keefer (1997)	Defines "Putnam-esque" groups as those that "instill in their members habits of cooperation, solidarity and public spiritedness" and "Olsonian" groups as those that serve as distributional coalitions".
Narayan and Pritchett (1999)	The quantity and quality of associational life and related social norms
Putnam (1995)	Features of social organization such as networks, norms, and social trust that facilitate coordination and cooperation for mutual for mutual benefit
Uphoff and Wijayaratna (2000)	*Structural* social capital includes "roles, rules, procedures and precedents as well as social networks that establish ongoing patterns of social interactions" *Cognitive* social capital includes, "norms, values, attitudes and beliefs that predispose people to cooperate".
World Bank website (2001)	The norms and social relations embedded in social structures of societies that enable people to coordinate action to achieve desired goals
Woolcock and Narayan (2000)	The norms and networks that enable people to act collectively • "the *communitarian* perspective equates with local organizations such as clubs, associations and civic groups • the network perspective "stress the importance of vertical as well as horizontal associations between people and of relations within and among such organizational entities such as community groups and firms • The institutional view argues that the vitality of community networks and civil society is largely a product of the political, legal and institutional environment • the synergy view attempts to integrate the compelling work emerging from the networks and institutional camps

Adopted from Hedad and Maluccio (2003)

First and most important for this study, major emphasis will be placed on the transfer of knowledge about technology and markets. Social capital may reduce levels of poverty through positive externalities of knowledge transfer about adoption of agricultural technologies leading to increased agricultural productivity, and therefore household incomes. Diffusion of innovations are facilitated by linkages among individuals. Studies that show the importance of social capital in knowledge transfer and diffusion of technologies include Narayan and Pritchett (1999), Isham (2000) and Reid and Salmen (2000). Chapter 3 of this thesis also shows that social capital enhances adoption of traditional technologies such as terracing, fallowing and less of the other technologies. These studies show that social participation in-group activities, interconnectedness with the social systems, are positively associated with early adoption of technologies.

As Collier (2002) argues, the transmission of knowledge can occur through pooling in the case of networks and clubs or through copying which requires one-way interactions. He argues further that copying tends to be distributionally progressive, except where barriers of social segmentation are high. Such segmentation may include gender, income or ethnic divide among others. Research on adoption of innovations suggest that village level spillovers played a role in individual adoption decisions (Foster and Rosenzweig, 1995) but they do not examine the role that social capital may play in mediating village level effects. Such adoption of technologies/innovations is expected to increase agricultural productivity and hence household incomes.

Social capital may reduce market failures in information, which lowers transactions costs and provides a great range of market transactions in output, labour, credit and land leading to higher household incomes. This can be information about prices, products and behaviour of other members among others. For example, considering the credit market, there are two mechanisms through which social capital can lead to reductions in transactions costs. Social

capital could lead to a better flow of information between creditors and borrowers and hence reduce adverse selection and moral hazard problems in the credit markets. Secondly, social capital also expands the range of enforcement mechanisms for default on obligations in an environment in which recourse to the legal systems is costly or impossible.

Secondly, in his thesis, Collier (2002) also argues that the poor have a lower opportunity cost of time and a lower stock of financial and physical capital than the rich. Since social interaction is time intensive and social capital can often substitute for private capital, the poor may choose to rely more on social capital than the better off. Collier's argument suggests that social capital may ameliorate other resource constraints such as farm equipment, credit, and other inputs important in the production process that would have otherwise been obtained in the market, thus reducing the vulnerability of the masses to poverty. As Putnam (1993a) puts it, "in rural agrarian households, social capital allows each farmer to get his work done with less physical capital in form of tools and equipment because of the borrowing and lending of these tools in the communities".

Third, social capital may also facilitate greater cooperation in the direct provision of services that benefit all members of the community and hence improve household well-being. Work by Ostrom (1990; 2000) suggest that the ability of local groups to cooperate plays a significant role in avoiding the negative consequences of the excessive exploitation of assets that would result from purely individualistic behaviour in open access situations. For instance, Ahuja (1998) shows that in Ivory Coast, the degree of land degradation was worse in more ethnically heterogeneous villages. This result suggests that it is the difference in social factors that may affect the effectiveness of community controls because heterogeneous communities tend to have less cohesion and therefore trust.

Lastly, Alesina and La Ferrara (2000) argue that social capital measured, as participation in associations is highly correlated with political participation and the latter has critical implications for policy choices. Social groups bring out voices of the poor against marginalisation by the wealthy and educated elites. Putnam's work in Italy also concludes that the regions of Italy in which the populations had greater degree of horizontal connections, had more efficient governments. The possible mechanism through which these horizontal connections work is through efficient monitoring of government provision of services and hence better household welfare.

On the other hand literature on determinants of group participation is not well developed. Alesina and La Ferrara (2000) develop a model that links group participation with income inequality, cluster variations in economic activity, race and ethnic origin. The results show that lower trust reduces participation in open groups. Other important factors determining group participation in the literature include, education, age, marital status, and sex (See Alesina and La Ferrara, 2000; Christoforou, 2004).

5.3 Analytical framework

Our premise of analysis is that social capital defined as membership in agrarian associations or groups increases household incomes and therefore reduces poverty. This suggests that poverty measured by household per capita expenditure is a function of social capital such that;

$$Y = f(S, Z) \text{.....} 5.1$$

Where Y represents per capita household expenditure, S is the social capital variable measured in terms of group membership and Z is a vector of other independent variables. This formulation is in line with earlier studies Grooteart

(1999) in Indonesia, Grooteart and Narayan, (2004) in Bolivia and Narayan and Pritchett (1999) in Tanzania.

On the other hand however, income levels can influence or determine many indicators of social capital. For instance, if membership in some associations requires membership fees or monthly/annual subscriptions, this would suggest that the higher the incomes the greater the ability to join some of these associations. Secondly, social capital can be considered as an input into the household production function and can therefore be modeled similar to human capital and other household asset endowments (Grooteart, 1999; Grooteart and Narayan, 2004). However, social capital can also be partly consumption good. This is more so in non-mandatory social groups pursuing leisure activities. Since leisure is a luxury good, demand for leisure increases with income, this leads to a reverse causation from welfare level to social capital. This suggests that;

$$S = g(Y, X).....5.2$$

Where X a vector of other independent variables and all other variables remain as defined above. This formulation is also in line with earlier studies such as Alesina and La Ferrara (2000) in the USA, Christoforou (2004) in European countries and Haddad and Maluccio (2003) in South Africa that examined determinants of group memberships.

This formulation suggests a two-directional/two-way causality link between income and social capital. There is therefore need for an empirical model that takes into account the possible endogeneity and/or simultaneity problem between social capital and household income. The model used in this study is presented and discussed in the next sub-section.

5.4 Empirical model to analyse the determinants of poverty and group participation

The presence of possible endogenous regressors would require specifying a system of simultaneous equations. The method of least squares is not appropriate because the endogenous variables are correlated with the disturbance terms. Applying OLS models without correcting for endogeneity may therefore lead to biased and inconsistent estimators leading to incorrect inferences. More so, our social capital variable is a discrete choice variable, defining membership to agrarian associations (member = 1, non-member = 0), suggesting the use of a two-stage estimation involving discrete and continuous dependent variables.

Following Alvarez and Glasgow (1999) the non-recursive two-stage choice model of this nature may be specified as follows;

$$S^* = \gamma_1 Y + \beta_i X_i + \varepsilon_1 \text{.....(5.3)}$$
$$Y = \gamma_2 S^* + \alpha_i Z_i + \varepsilon_2 \text{.....(5.4)}$$

Where Y is the continuous per capita household expenditure variable, S* is the binary choice social capital variable, X and Z are vectors of independent variables, ε_1 and ε_2 are the error terms for equations (5.3) and (5.4) respectively and $\gamma_1, \gamma_2\ \alpha_i, \beta_i$ are the parameters to be estimated. However, we do not directly observe the latent variable S* instead we observe the choice made by an individual which takes value 1 if member of a group and 0 if non-member, such that,

$$S = \begin{cases} 1 & if \quad S^* > 0 \\ 0 & if \quad S^* \leq 0 \end{cases} \text{.....(5.5)}$$

Thus the reduced form equations would thus be written as,

$$S = \pi_i X_i + \pi_i Z_i + v_1 \text{.....(5.6)}$$
$$Y = \lambda_i X_i + \lambda_i Z_i + v_2 \text{.....(5.7)}$$

To avoid biased coefficients and inference problems associated with endogeneity and given the nature of one of the dependent variable used in this model, two estimation procedures are suggested in the literature. First is the two-stage probit least squares (2SPLS) approach (Maddala, 1983; Alvarez and Glasgow, 1999). To implement the 2SPLS approach, the reduced form equation for the continuous variable (equation 5.7), is estimated using OLS, while the reduced form of the binary choice variable (equation 5.6) is estimated using a probit model. The parameters from the reduced form equations are then used to generate a predicted value for each endogenous variable and these predicted values are then substituted for each endogenous variable as they appear on the right hand side of the respective equations (5.3 and 5.4). Then the equations are re-estimated using the predicted values from the reduced form equations serving as instruments on the right hand side of the original model equations.

The advantage of using the 2SPLS approach is that it can be applied to either a binary dependent variable with a continuous endogenous regressor on the right hand side or a continuous dependent variable with a binary endogenous regressor on the right hand side. However, according to Green (2000) and Alvarez and Glasgow (1999) the major draw back of 2SPLS is that the standard errors produced are biased and their correction is difficult. This implies that statistical inference would not be legitimate. One solution is to use the consistent 2SPLS parameter estimates along with bootstrapped standard errors.

Bootstrapping is a statistical technique where the sampling distributions for the parameter estimates of interest are simulated through an iterative process (Mooney and Duval, 1993; Mooney, 1996). The advantage of bootstrapping is

that it allows for the creation of confidence intervals for statistics where sampling distributions are unknown or in the case of the 2SPLS, are difficult to estimate.

Secondly, Rivers and Vuong (1988) developed what they termed as the two-stage conditional maximum likelihood (2SCML) approach to obtain consistent and asymptotically efficient estimates for the probit equation. It therefore mitigates the problems of incorrect standard errors directly and no need of bootstrapping in this case. The limitation of this approach however is that unlike the 2SPLS, which allows the dependent variable to be either binary or continuous, the 2SCML approach assumes interest in only the structural parameters of the probit equations. To estimate the probit coefficients and their variances following in the 2SCML method requires to first estimate the reduced form of the continuous variable equation, obtain the residuals from the reduced form regressions and add these residuals to the probit equation for the binary choice variable as an additional variable with a corresponding parameter to be estimated.

To identify the determinants of poverty, this study, uses both the 2SPLS approached with boot strapped standard errors and compare the results with those of a 2SPLS without bootstrapped errors. On the other hand, to identify the determinants of group participation, results from the 2SPLS approach and those generated by 2SCML approaches are compared.

Before model implementation, the independent variables were first scrutinised for possible correlations since multi-colinearity is a common problem with such data sets. A number of variables that were believed to be strongly correlated with others were dropped. The Huber-White sandwich estimator was also used to correct for possible heteroscedasticity of unknown form (White, 1980). The next sub-section presents and discusses the measurement of the variables used in the analysis.

5.5 Definitions and measurement of Variables

- ***Controlling for the effect of Poverty***

Per-capita household expenditure is used to represent poverty. The major assumption is that consumption expenditures are negatively related with poverty. Thus factors that increase consumption expenditure would reduce poverty. This is one of the most widely used approaches (Geda et al., 2001; Mukherjee and Benson, 2003).

To compute the per capita household expenditure, data from Uganda National Household Survey (UNHS, 2002) are used. Our household expenditure variable is made up of four components that include: total food consumption expenditure whether purchased or from home production, total non-food expenditure on durable and non-durable goods, and non-consumption expenditure such as taxes. The welfare indicator is expressed in real terms normalised using 1989 as the base year. Using per capita expenditure in this case assumes (i) everyone in the household receives an equal allocation of items consumed irrespective of age and gender. (ii) Everyone has the same needs irrespective of age and gender, (iii) the cost of two or three or more people living together is the same as if they lived separately (Mukherjee and Benson, 2003).

- ***Controlling for the Social Capital effect***

Our hypothesis to be tested in this case is that social capital increases household incomes and therefore reduces poverty. We further hypothesise that the impact of group memberships on poverty depends on the type of group in which a particular household participates.

As a result of the diverse definitions of social capital, one major criticism of the notion of social capital is that it is very difficult to measure, hence difficult

to use in empirical analysis. There are various proxies or indices that have been used to measure social capital in the literature. Key among these are membership in local associations and networks (Narayan and Pritchett, 1999; Alesina and La Ferrara, 2000; Grootaert, 1999; Grootaert et al., 1999), indicators of trust and social norms (Heddad and Maluccio, 2003) and indicators of collective action. This survey did not collect information on trust and social norms, however collected information on associational life of households and communities in the study areas that can be used to assess the impact of social capital on poverty.

In this study, one critical component of social capital, namely, participation in associational activities such as religious, youth, women, savings, burial groups is used. Use of participation in group activities is motivated by Putnam (1993b), who argues that participation in social groups may lead to the transmission of knowledge and may increase aggregate human capital and the development of trust which improves the functioning of markets. Putnam (1993b) argues that associations instil in their members habits of cooperation, solidarity and public –spiritedness". Gronovetter (1985) argues that group participation may also create strong internal solidarity and trust, commonly referred to as bonding in the social capital literature.

- ***Other explanatory variables***

In selecting our potential regressors, we were guided by the results of the poverty profile of the UNHS, 2002/03, results of the Uganda poverty participatory assessment project (UPPAP) and the literature on determinants of poverty. The set of regressors that we choose as possible determinants of poverty, their definition as well as their expected signs of influence are given in Table 5.2. The variables were therefore chosen if there were strong theoretical reasons and according to the literature. A key challenge however in the choice of these variables is identifying only the exogenous variables**.**

Table 5.2: Definition of variables used in the analysis

Variable	Definition	Values/measure	Model 1	Model 2
Non-Farm Inc.	Non-farm income	Uganda shillings	+	+/-
Livestock	Livestock in Tropical Livestock Units (TLU)	Average TLU for common livestock in Uganda is cow = 0.9, Oxen = 1.5, sheep or goat = 0.2, calf = 0.25	+	-
Agro-ecology	Defined by productivity potential	Dummy (Highland=1 and others=0)	+	+
Dist S. Road	Distance from plot to seasonal road	Kilometres	-	+
Agric extension	Access to agricultural extension information	Dummy (1=if household had access to an extension agent in 2002, 0=if not)	+	-/+
Education	Education for household head	Number of years	+	+
HH-age	Age of household head	Number of years	+	+
Sex	Sex of household head	1=Male and 0=Female	+	+
HH-size	Size of household	Number of household members	-	----
Social time	Time spent in organisation activities	Hours	+/-	----
Origin of ins	Whether institution one is member of is local or foreign initiated	1 if local and 0 if foreign	+	----
Ethnic Dom.	Proportion of dominant ethnic group in the village	Proportion of dominant ethnic group in the village	+/-	+/-
Farm size	Size of a farm a household owns	Acres	+	----
Marital Status	Whether married or not	Dummy (married=1 and not married=0)	----	+

Model 1: Determinants of poverty; Model 2: Determinants of group participation;

5.6. Results of the econometric analyses

5.6.1 Determinants of poverty

As mentioned earlier, this study uses household expenditure as the measure of poverty among farmers. This section presents results on the determinants of poverty as measured in terms of household expenditure. The estimates of the second stage equation for poverty as well as the estimates of the second stage equation for poverty with bootstrapped standard errors are presented in Table 5.3. Though the results are closely related, inference is different for some variables. The results of the second stage equation for poverty with bootstrapped standard errors are therefore discussed in this case because as earlier discussed in section 5.3 they present more legitimate standard errors. The Wald test suggests that the null hypothesis that social capital is exogenous is rejected at 5 percent level of significance and therefore justifies the use of the 2SPLS.

Table 5.3: Second stage results of determinants of poverty

	2SPLS		2SPLS With Bootstrapped Errors	
Variable	**Coeff.**	**P-level**	**Coeff.**	**P-level**
Social capital	0.2325***	0.0010	0.2325***	0.0000
Education	0.2255***	0.0000	0.2255***	0.0000
HH-size	-0.3776***	0.0000	-0.3776***	0.0000
HH-age	0.3342***	0.0000	0.3342***	0.0000
Dist S. Road	-0.0297***	0.0010	-0.0297**	0.0350
Non-Farm Inc.	0.0182**	0.0460	0.0182	0.1770
Livestock	0.0357***	0.0000	0.0357***	0.0000
Sex	-0.0330	0.4330	-0.0330	0.4040
Agro-ecology	0.1981***	0.0000	0.1981***	0.0000
Extension	0.0807***	0.0090	0.0807**	0.0140
Farm size	0.0217***	0.0090	0.0217***	0.0070
Origin of ins.	-0.1432***	0.0020	-0.1432***	0.0000
Constant	8.6526***	0.0000	8.6526***	0.0000
Regression Diagnostics				
Number of Obs.	1695		1695	
R-Squared	0.1613		0.1613	
Prob > F/ Prob > Chi2	0.0000		0.0000	
Replications			100	

Notes: *, **, and *** represent the level of significance at 10, 5 and 1 percent respectively

Most variables have the expected signs and are consistent with expectations, save for a few cases discussed latter. For instance, we find that an increase in the level social capital stock and its use significantly increases the level of household expenditure. In fact the impact of social capital on poverty is equal in magnitude to that of education. These findings support those in earlier studies (Narayan and Pritchett, 1999; Grootaert, 1999; Tiepoh and Reiner, 1999; Grootaert and Narayan, 2004) that found social capital to be positively related to household income and welfare.

Also, returns to investment in social capital are higher for those households in production related institutions than those in social institutions, though membership to either institution produces positive welfare benefits (Appendix 6). These findings suggest that in Uganda where poverty analysis focuses on other forms of capital ignoring the social structures through which poverty reduction policies and programs operate could be missing a large part of the poverty puzzle. The pathways that explain this linkage as earlier highlighted could be sharing of information among members, the reduction of opportunistic behaviour as a result of social pressure and facilitation of collective decision-making (Grootaert, 1997; Collier, 2002). Each of these pathways could easily translate into improved household income and welfare.

The results suggest that government poverty reduction programs need to take into consideration existing social structures. To have an efficient public intervention process and given the different impacts of different policy variables on incomes/poverty levels of different groups, government needs to do the following. First, understand the nature and objectives of the existing social institutions through which poverty reduction programs may be channeled. This may help identify different intervention programs for different social groups. For instance, the result that returns to investment in social capital are higher for those households in production related institutions than those in social institutions suggests an intervention strategy that would enable existing social institutions to

offer services as those in production related associations over and above the social objectives would also enhance their performance.

Secondly, government should work with existing social institutions for the design and delivery of projects. For instance, government extension and micro-finance services may exploit the existence of such institutions. The advantages of this approach that encourages interaction between policy makers and social institutions are i) it improves beneficiary targeting, ii) reduce project costs, iii) enhance sustainability and strengthen social organizations. Lastly, government should invest in social capital and also facilitate an enabling environment to foster and strengthen the social capital in the country. This could be done through direct investments e.g. through provision of financial support, supply of equipment (e.g. tractors), infrastructure development (e.g. Silos), training and capacity building for local organizations or indirectly by providing an enabling environment for their performance (legal framework).

Being a member of a local community oriented organization however, reduces household expenditure and therefore increases poverty. This is contrary to other authors who suggest that organizations that find their roots in the communities tend to be more effective in achieving associational objectives than externally imposed organizations. One possible explanation for this outcome is that local associations tend to be homogeneous in their nature (same characteristics such as level of education, ethnic group, levels of income and general exposure to the outside world). Such associations tend to reinforce conservatism and are likely to enjoy limited success to ways of acquiring and generating new skills and knowledge. Therefore access to a variety of heterogeneous ties offers a highly effective way of assessing and generating a broad range of new knowledge and therefore, critical for innovation. Grootaert, (1999) finds that potential pool of knowledge to be shared among rural farmers in Indonesia is higher among heterogeneous associations.

The education variable is found to be positively and significantly related to household expenditure and therefore reduces poverty. This outcome can be explained by two factors, first, the higher the level of education attained the greater the opportunities for gainful employment and therefore better household welfare. Secondly better-educated households have better access and ability to process new information (information on extension, credit facilities, family planning, hygiene, markets among others) and therefore use such information for their own benefits. From the policy perspective, provision of quality education for rural households therefore would be crucial in the fight against poverty. Continued government support for free primary education, adult literacy programs and other productivity enhancing training opportunities could be of paramount importance in poverty reduction.

Ownership of physical assets captured in this study by farm size and total livestock a household owns were found to improve household welfare. The impact of increasing both livestock and farm size on household expenditure is positive and significant at one percent. In rural Uganda, which is a focus of this study, higher earnings depend on asset ownership, particularly land, because land is a fundamental productive asset, a means of generating wealth, and acts as a cushion against shocks and reduces vulnerability of the population to poverty. Deininger (2003) shows that land in Uganda constitutes 50-60 percent of the total asset endowments of the poorest households. Interventions to modify the rules that determine access to land and the way land is distributed among members of a community may have an impact on efficient utilization of land, incidence of poverty and the level of inequality. This can be achieved through land laws that would encourage equitable land distribution. On the other hand, livestock assets are a source of cash for investment in other forms of capital and an insurance against uncertainties, and hence the positive relationship with household expenditure.

Household size was found to have an inverse relationship with household expenditure and by implication, a positive relationship with poverty. This is a common finding in the literature (Grooteart, 1999; Lanjouw and Ravallion, 1995; Datt and Jollife, 1999). This finding suggests that larger households are likely to be poorer than small households, other factors constant. This relationship could be explained by two factors. Chapter three of this thesis has already shown that, in the study area, the poor also tend to have more children. This simply means more dependants and hence lowers per capita expenditure. Other factors constant, an extra child reduces per capita expenditure of the household. Children contribution to productive labour is low and therefore the labour supply effect would not be felt. This is especially so in Uganda, where the introduction of free universal primary education has reduced children labour supply for basic home chores and farm management.

Secondly, the inverse relationship can also be explained by the economies of household size in consumption. Size economies in consumption exist if the cost per person on certain expenditures such as rent, durable and non-durable goods are lower. Size economies and labour supply are expected to increase household expenditure. However, Lanjouw and Ravallion (1995) show that these factors can only positively influence household expenditure after a certain critical level of expenditure has been reached. Lanjouw and Ravallion (1995) estimate this critical value of size economies in consumption to be 0.6 for Pakistan. The age of the household head is positively related to household expenditure. This finding suggests that households headed by older people other factors constant; tend to be better off than those headed by younger people. This is again as expected since older household heads would have accumulated productive assets such as land as opposed to the younger generations, still struggling to build their homesteads.

Access to road infrastructure is expected to reduce household poverty, because of improved access to input and output markets, non-farm opportunities as well

as services such as education, health facilities, among others. As expected therefore, the results show a negative relationship between distance to seasonal road and household expenditure. This finding suggests that the further away from seasonal road a household is the poorer it becomes. Intervention in the provision of roads infrastructure is a key component in the poverty reduction policy. Agricultural extension is expected to positively influence household income through its impact on agricultural productivity. The results show a positive and significant impact of access to extension services on household expenditure. Interventions in the provision of extension services to the poor therefore would improve productivity of poor farmers and enhance household welfare. Detailed discussion on the direction and implementation of such extension program was covered in chapter four of this dissertation.

An agro-ecological zone dummy variable was introduced to control for agro-climatic effects on household welfare. As noted before, Uganda's agro-ecologies are broadly categorized into two major classifications, as uni-modal and Bi-modal rainfall zones by Ruecker et al. (2003). This classification was based on the average length of growing period, rainfall pattern, maximum annual temperature and altitude. The results show that households based in the bi-modal rainfall zones are generally better off than households in the uni-modal rainfall zones. This result seems to suggest that favourable climatic conditions such as long growing periods, rainfall patterns among others in the bi-modal zones partly explain differences in poverty levels, earning capacity and agricultural output. Birungi et al. (2006) and Okwi et al. (2005) have also shown empirically that such environmental factors are key in explaining household welfare differentials throughout the country.

This section has shown that among other factors, social capital is very important for poverty reduction. We therefore need to come up with appropriate policies to generate and facilitate the functioning of social capital. To learn about such potential policies, requires an understanding of the factors that may influence

group participation as a measure of social capital used in this study. In the following section, guided by the literature discussed in section 5.2, we present and discuss results to explain the determinants of group participation.

5.6.2 Determinants of group participation

In this section, the determinants of group participation are discussed. As highlighted earlier, group participation is our measure of social capital. Results of the 2SPLS are presented along with results of the 2SCML approach (Table 5.4). The results from 2SCML approach are very close to those calculated under the assumption of normality of the estimators. The results of the 2SCML approach are therefore discussed in this case because as earlier discussed in section 5.4 they present more legitimate standard errors. The Wald test suggests that the null hypothesis that household expenditure is exogenous is rejected at 5 percent level of significance and therefore justifies the use of the 2SPLS and 2SCML approaches.

Table 5.4: Estimate of the second-stage equation of determinants of group participation

	2SPLS		2SCML	
Variable	**Coeff.**	**P-level**	**Coeff.**	**P-level**
HH-Expenditure	0.6798***	0.0000	0.6882***	0.0000
Education	0.0898	0.2730	0.0853	0.2990
HH-age	0.2953**	0.0240	0.2956**	0.0240
Non-Farm Inc.	0.0439*	0.0550	0.0438*	0.0560
Livestock	0.0302	0.1950	0.0310	0.1850
Sex	0.3246***	0.0080	0.3200***	0.0090
Extension	0.0132	0.8690	0.0118	0.8830
Ethnic dom	-0.4625	0.1580	-0.4615	0.1600
Dist S. Road	0.1807***	0.0000	0.1802***	0.0000
Marital status	0.1411***	0.0060	0.1345***	0.0090
Constant	-7.2337***	0.0000	-7.2913***	0.0000
Regression Diagnostics				
Number of Obs		1695		1695
Log likelihood		-805.6497		-805.0183
LR chi2(10)		117.81		119.07
Prob > chi2		0.0000		0.0000
Wald Test of exogeneity				
Chi2(1)				10.21
Prob > chi2				0.0014

Notes: *, **, and *** represent the level of significance at 10, 5 and 1 percent respectively

The results show that household expenditure is positively and significantly associated with the formation of social capital or group participation. A further examination shows that the impact of household expenditure on participation in these groups is greater for those who join social institutions (Appendix 7). These findings suggest that individuals with higher incomes are more likely to join the associations as a leisure or consumption good more than their poor counterparts. Also literature suggests that relative status derives social engagements. In rural Uganda, income can therefore be seen as a proxy for relative status. Others suggest that the poor lack the incomes to afford group memberships or spend their plentiful time securing a source of minimum income rather than participate in-group activities.

The study also shows a positive relationship between non-farm incomes and the probability of joining social institutions. This could be capturing the impact of associations for owners of non-farm enterprises. Owners of non-farm enterprises tend to join associations to acquire information on credit, technology, markets and inputs in their production process. Bar (2000), for instance shows that social net-works among Ghanaian entrepreneurs serve to channel information about new technology and Fafchamps and Minten, (1999) show the importance of business networks in conveying information about employment and market opportunities.

The results show a positive correlation between social capital formation and education. Households with a head with more years of schooling are more likely to join social institutions. The significance of education in enhancing individual incentives to group membership has been confirmed in the literature by empirical work based on regression analyses such as Godquin and Quisumbing (2005), Christoforou, (2004), Gleaser *et al*. (2000), and Alesina and La Ferrara (2000). There are alternative explanations of this outcome. Better-educated households may have a higher demand for group membership because they can more easily

benefit from the positive externalities. Secondly, education is viewed as a way of creating opportunities for collective action, either through offering access to social networks and personal acquaintances, or through cultivating values and morals leading to a sense of citizenship and solidarity (Christoforou, 2004; and Alesina and La Ferrara, 2000). Another factor in the literature that explains the social capital-education relationship is the idea that social skills are learned from schools.

Gender and marital status are also determinants of social capital. In general, the gender variable (Sex) captured in this study as a dummy variable that takes the value of one if male and zero if female is positively and significantly related to social capital. Being male increases the probability of joining a group. A critical examination reveals that males tend to have a high probability of joining social institutions and reduced probability of joining production institutions (Appendix 7). This result could partly be explained by the fact that women carry the biggest burden of family and household chores such as child rearing. Also being married significantly increases the probability of group membership. This suggests that family obligations do not hamper incentives for group membership, but instead encourages for the family to be able to meet their needs.

The results also show that there is a positive relationship between age of household head and participation in associational activities. Alsina and La Ferrara (2000) justify a similar finding that younger households are particularly busy because of marriage, having children and setting up new households. The older however may participate more, since they have more time than their younger counterparts.

Poor road access measured in this study as the distance to nearest seasonal road increases the probability of participating in group activities. This could be seen as a survival strategy to reduce transactions costs of acquiring and sharing information, and solving their social needs, in order to mitigate public sector

failures of road provision. More interestingly, distance to seasonal roads reduces the probability of joining production institutions and more of social associations. This is expected because of the inherent constraints created by poor road infrastructure on production related institutions.

5.7 Conclusions and policy recommendations

In this paper, we have undertaken the task of investigating how social capital may impact on household poverty. Specifically we were interested in establishing the impact of participating in an agrarian association on household level poverty. Our basic premise was that social capital increases household incomes and therefore reduces poverty. However it was also observed that the level of household expenditure might also determine certain components of social capital, thus suggesting an endogeneity problem. The presence of endogenous regressors therefore led to the use of econometric techniques such as the 2SPLS and 2SCML that control for endogeneity. Using two nationally representative data sets, our main conclusions and policy implications are summarised as follows:

i) Social capital defined in terms of membership to local and other organizations positively impacts on household income and therefore reduces poverty. Households that invest in social capital tend to be much better off than their non- participating counter parts. The impact of social capital on household welfare compares well with that of other forms of capital such as human capital. The policy implication of this finding is that the government should invest in social capital, by supporting the emergence and functioning of local associations. This can be achieved by incorporating social capital in the poverty reduction strategies. Incorporation of social capital in the national poverty alleviation strategy would be an important component since the returns to investment in social capital are larger for the poorest of the society.

ii) We also observe that homogeneous associations measured by being a member of a local community oriented organization tend to be welfare decreasing. This may be associated with inbreeding and conservatism associated with and common in these institutions. The policy implication of this finding is that, there is need to develop a policy that bridges the associations with other local, national and non-governmental organisations. Capacity building programs on production technologies, and market information access using the moblisation infrastructure of the local institutions would be of significant importance. This can be achieved through the government extension infrastructure or through the relevant non-governmental institutions to break the information boundaries.

iii) Education is a crucial factor that determines household incomes but also has strong positive influence on the probability of joining social groups. Public intervention in the provision of quality education for rural households therefore would be crucial in the fight against poverty. Continued government support for free primary education, adult literacy programs and other productivity enhancing training opportunities could be of paramount importance in enhancing social participation and poverty reduction.

iv) Results show that household expenditure is positively and significantly associated with the formation of social capital or group participation. This suggests that continued government effort to increase household incomes especially taking into consideration the existing social institutions will go a long way to encourages associational growth and performance and therefore reduce poverty.

CHAPTER VI

SUMMARY, CONCLUSIONS AND IMPLICATIONS FOR POLICY AND RESEARCH

Policy makers in Uganda face a formidable task of enhancing agricultural productivity, and ensuring sustainability of the natural resource base on which the majority of the population depend for their livelihood. It has been observed that land degradation in Uganda manifested through soil nutrient loss and soil erosion poses a threat to national and household food security and the overall welfare of the rural population. Uganda is said to have one of the highest rates of soil nutrient loss and soil erosion in sub-Saharan Africa.

Surprisingly, despite the extent of the land degradation problem, and government effort to contain soil erosion and reverse soil nutrient mining by promoting use of SFM and conservation technologies, the rate of adoption of these technologies is low. These trends of events suggest that unless immediate intervention is put in place, land degradation and therefore household welfare are bound to continue worsening. Among other factors, poverty has been blamed for the low rates of adoption. It has been argued that the poor living barely on subsistence level do not have economic capacity to use purchased inputs such as inorganic fertilizer. More so, the limited access to productive assets by the poor (livestock, land, and non-farm income) constrains their ability to engage in improved land use practices such as terracing and fallowing among others.

Other factors considered to be conditioning the poverty-land degradation relationships in the literature include institutional factors (property rights), capital (physical, social, natural, financial and human), and other socio-economic factors of the areas of study. Among these conditioning factors, is the question of social capital that has attracted minimum attention from both academics and policy makers in Uganda. Social capital can influence land degradation-poverty interaction through the following ways:-

i) it facilitates transmission of knowledge about technology and markets, reducing market failures in information and therefore reducing transactions costs (costs of obtaining information about technology, market, creditworthiness of contract parties among others).
ii) Reducing problems of free riding and thereby facilitating cooperative action,
iii) Enhancing coordination and monitoring effective public services delivery,
iv) Ameliorating other conventional resource constraints such as market access or credit limitations and thus reduce vulnerability of households to poverty.

Studies that have incorporated social capital in determinants of adoption of SFM and conservation technologies in Uganda on one hand and determinants of poverty on the other are non-existent. More so, studies that analyse the determinants of social capital formation are also non-existent. To appropriately address the twin problems of land degradation and poverty, and avoid the down-ward spiral suggested in the literature, there was need therefore to understand the underlying causes of low adoption rates and the determinants of poverty in the country.

The goal of this study was therefore two fold. First, the study investigated the determinants of SFM and conservation practices in Uganda, with particular interest on the role played by poverty, social capital and land tenure in explaining adoption of these technologies. Secondly, the study provided an understanding of the causal relationships between social capital (measured by group membership) and poverty. Specifically, the study investigated the importance of social capital in explaining household poverty as well as the importance of poverty in explaining participation in social agrarian groups. It was hoped that understanding these key relationships would help policy makers design appropriate policies addressing the needs of the poor communities in the country.

The study utilised a data set from a survey conducted by IFPRI and the World Bank, in collaboration with the Uganda Bureau of Statistics (UBOS). The survey covered eight districts of Arua, Iganga, Kabale, Lira, Kapchorwa, Masaka, Mbarara and Soroti. The districts were chosen to take into consideration the different agro-ecological zones, level of poverty, farming systems, land tenure and endowment of natural resources in the country.

Econometric approaches were used to establish the determinants of adoption of SFM and conservation technologies and to establish the empirical relationship between social capital and household poverty in Uganda. To establish the determinants of adoption of SFM and conservation technologies, a multinomial logit (MNL) model was used. Choice of MNL was motivated by the need to address the interdependent and joint nature of the adoption decision making. A two-stage probit least squares 2SPLS was used to correct for possible endogeneity effects, associated with the poverty-SFM and conservation relationships. In the second part of the study, a linear regression model was used to understand the determinants of poverty in Uganda while a probit model was used to capture the determinants of group participation, our measure of social capital. In order to correct for the endogeneity problem associated with poverty and social capital (involving discrete endogenous dependent variables), a two stage non-recursive procedure was used. The 2SPLS and two stage conditional maximum likelihood (2SCML) approaches were used to correct for possible endogeneity effects associated with social capital-poverty relationship.

Key findings emerged from this study. The study shows that poverty measured by household consumption expenditure increases the probability of non-adoption in general and particularly reduces the probability of adopting organic and inorganic fertilizers and terracing. This result was attributed to the fact that the poor have limited access to cash, markets, land and livestock assets which constrain their productive potential. This finding suggests that government

programs to reduce poverty would go a long way in promoting the use of SFM and conservation practices.

The study also found that participation in social institutions generally tends to increase the probability of adopting most land management practices and generally reducing non-adoption. This finding suggests that investment in social capital is therefore of paramount importance to encourage adoption of SFM and conservation technologies. Two policy implications of this outcome are clear. First, the results suggest that development projects should not be designed so that they deal with all communities uniformly, but be adapted to different levels of existing social institutions and norms. For instance extension programs need to put emphasis on pre-project analysis and preparation so as to assess and identify farmer circumstances including formal and informal institutional constraints. Secondly, extension workers should understand the institutional set up in their areas of work and be able to promote and exploit the existing institutional infrastructure for the dissemination of information about new technologies and encourage cooperative action.

Also land tenure security was found to be positively correlated with adoption of fallowing and organic fertilizer use and generally reducing the probability of non-adoption of land management technologies. These results also suggest that programs that enhance tenure security such as land registration would encourage adoption of most land management practices. In addition, distance to markets was found to reduce use of marketed inputs, such as inorganic fertilizer while increasing use of traditional technologies such as fallowing. From a policy perspective, these findings suggest that public intervention in road provision would reduce non-adoption of marketed inputs.

The results further show that agricultural extension doesn’t significantly affect adoption of most of the technologies except use of inorganic fertilizer. This result has been attributed to the fact that the extension system in Uganda has been

packaged to promote use of inorganic fertilizer in an effort to intensify agricultural production at the expense of traditional practices. More so, the weak relationship between extension and adoption decisions is also attributed to inadequate and some times complete absence of extension services. Only 28 percent of the sampled households have had a single visit by an extension agent for a period of one year. The policy implication of this outcome is that there is need to revitalize the extension services and open it to support use of other traditional SFM and conservation technologies that are more readily available even to the poor farmers.

The study also shows that households that are endowed with family labour use more labour intensive management practices, while older farmers were found to be associated with traditional management practices such as fallowing because they tend to be more risk averse and therefore resistant to change to newer technologies. Differences in agro-climatic regions were also found to be key in explaining adoption of SFM and conservation practices. For instance, the likelihood of using fallowing and inorganic fertilizer in the bi-modal agro-climatic zones was substantially lower than in Unimodal agro-climatic zones. This finding was attributed to sparse population and organised fertilizer supply for maize/barley and tobacco farmers in Kapchorwa and Arua districts, respectively. On the other hand, the likelihood of using organic fertilizer and terracing is higher in the densely populated bi-modal agro-climatic zones, because of availability of family labour and ability to pay for hired labour, since these are labour intensive technologies.

In the second part of the study, determinants of both poverty and group participations are analysed. The results suggest that an increase in the level of social capital stock and its use increases the level of household expenditure. Households that invest in social capital tend to be less poor than those that do not invest. As argued earlier, these results show that government investment in social capital is of paramount importance to eradicate poverty and show that

earlier analyses that have neglected the role of social capital were missing an important part of the poverty puzzle. It is therefore important to incorporate social capital in the national poverty alleviation strategy since the returns to investment in social capital are large even for the poorest communities. Investment in social capital could be done through direct investments e.g. through provision of financial support, supply of equipment (e.g. tractors), infrastructure development (e.g. Silos), training and capacity building for local organizations or indirectly by providing an enabling environment for their functioning (legal framework).

Another interesting outcome was that homogeneous associations defined as membership in a local community oriented organization were found to be welfare decreasing. This outcome was associated with inbreeding and conservatism associated with and common in these kinds of institutions. The policy implication of this finding is that, there is need to develop a policy that promotes linkages and networking with other local, national and non-governmental organisations. Capacity building programs on production technologies, and market information access using the infrastructure of the local institutions would be of significant importance. This can be achieved through the government extension infrastructure or through the relevant non-governmental institutions to break the information boundaries.

Access to road infrastructure and provision of education to the rural masses as expected were found to reduce poverty in Uganda. Besides education providing greater opportunities for gainful employment it also helps in accessing and utilizing useful and productivity enhancing information hence improving household welfare. Access to road infrastructure improves access to input and output markets, as well as services such as education, communication, and health facilities. Public intervention in the provision of quality education and improve road infrastructure for rural households would therefore significantly contribute to poverty reduction. Other factors that were found to reduce poverty included ownership of physical assets such as land and livestock.

As regards group participation, the study shows that household expenditure, education and non-farm income increase the probability of participating in social capital institutions. The appropriate policy implications therefore remain as discussed in the previous sections.

In conclusion, the problem of identifying all the endogenous variables in cross section data sets of this nature remains a big challenge. The causal relationships between the different variables included in the model still remain debatable. This could have had an impact on the inferences made. Future investigations could therefore use other more advanced methods such as bi-probit or tri-variate probit in addressing some of the possible endogeneity problems. Secondly, final conclusions on the direction of causality between poverty and land degradation remains a challenge because of lack of appropriate data. Further research to effectively study causality of the two twin problems would require panel data containing plot level and household level information over time, given the inter-temporal nature of the two problems. Institutions that can help build a panel data set of this nature will go a long way in aiding the analysis and understanding of the existence of the twin problems.

Thirdly, this study did not cover how off-site effects of soil erosion can be managed. Some information could have been captured by the social capital variable, through the impact of social capital on encouraging cooperative action. The study however mainly provides solutions for onsite effects only. Landowners/users are expected to invest and manage their land to increase their productivity. Whereas it is in the interest of the farmers to invest in the control of on-site effects, management of off-site effects may require interventions from local social institutions, government and cross country initiatives among others. The policy implications of managing the off-site and on-site effects are therefore different. Further investigations to understand how off-site effects can be managed will be of great policy importance.

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Appendices

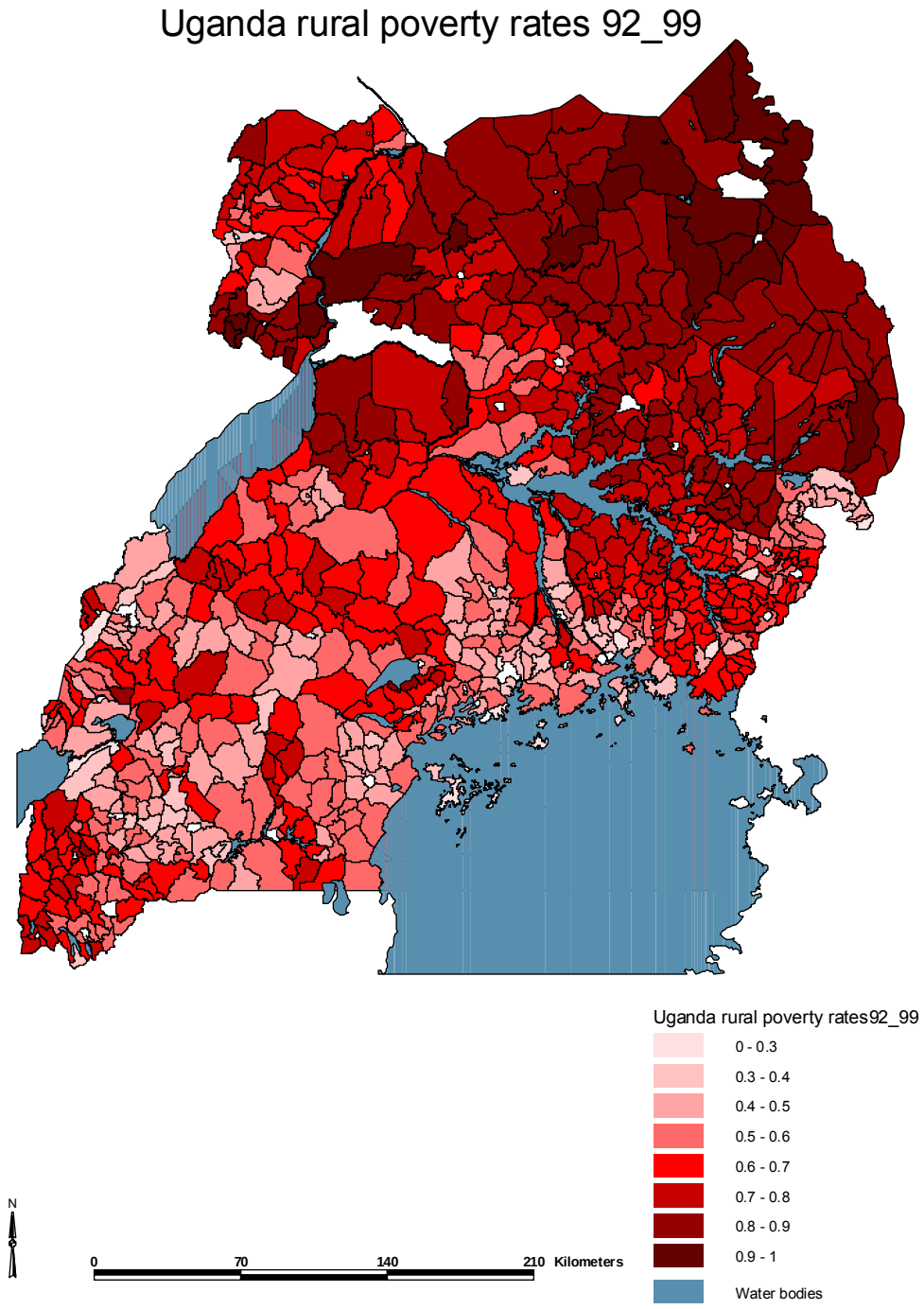
Appendix 1: Poverty Head Count Trends in Uganda, 1992/93 and 1999/2000
(Proportion of the population living below the poverty line)

	1992/93	93/94	94/95	95/96	96/97	1999/2000	2002/03
National	**55.5**	**52.2**	**50.1**	**48.5**	**44.0**	**35.2**	**37.7**
Rural	59.4	56.7	54.0	53.0	48.2	39.1	41.1
Urban	28.2	20.6	22.3	19.5	16.3	10.3	12.2
Central	45.5	35.6	30.5	30.1	27.7	20.3	22.3
Central-Rural	52.8	43.4	35.9	37.1	34.3	25.7	27.6
Central-Urban	21.5	14.2	14.6	14.5	11.5	7.4	7.8
Eastern	59.2	58.0	64.9	57.5	54.3	36.5	46.0
Eastern-Rural	61.1	60.2	66.8	59.4	56.8	38.4	48.3
Eastern-Urban	40.6	30.5	41.5	31.8	24.8	15.7	17.9
Northern	71.3	69.2	63.5	68.0	58.8	65.8	63.6
Northern-Rural	72.2	70.9	65.1	70.3	60.7	67.7	65.0
Northern-Urban	52.6	46.2	39.8	39.6	32.6	30.6	38.9
Western	52.8	56.0	50.4	46.7	42.0	28.1	31.4
Western-Rural	53.8	57.4	51.6	48.3	43.2	29.5	34.3
Western-Urban	29.7	24.9	25.4	16.2	19.9	5.6	18.6

Source: Appleton, 2001 and Appleton and Ssewanyana, 2003.

Appendix 2: Absolute poverty lines by region/place of residence
[In real terms (1997=100) per adult equivalent]

Region	Mean
National	21,409.49
Rural	
Urban	
Central rural	21,322.23
Central urban	23,149.64
Eastern rural	20,651.86
Eastern urban	22,125.24
Northern rural	20,871.98
Northern urban	21,799.82
Western rural	20,308.17
Western urban	21,625.72



Appendix 3: Map showing rural poverty in Uganda

Source: Birungi *et al*., 2006

Appendix 4: Indices and Measures of Poverty

In this section, the Foster-Greer-Thorbecke (FGT) poverty measures (Foster-Greer-Thorbecke, 1984) are discussed. The FGT indices for poverty measurements are the most commonly used in the literature. The welfare indicators measured by the conventional measures FGT (α) are given by equation 1. We report our estimates with p-values of 0 and 1 reflecting respectively poverty incidence, and poverty gap.

These poverty measures can be expressed as follows:

$$P_\alpha = \frac{1}{N}\sum_{i=1}^{M}\left[\frac{(z-y_i)}{z}\right]^\alpha \qquad (1)$$

Where z is the poverty line

y_i is income (or expenditure) of person i in a poor household

N is the number of people in the population,

M is the number of people in poor households

Different values of α in equation 1 give different poverty measures. When α=0, this formula gives the incidence of poverty or commonly referred to as the head count index. It reflects the proportion of the population of the people lying below the poverty line. This is because the term in brackets is always one, so the summation gives us the total number of people in poor households, which, when divided by N, gives us the proportion of people living in poor households. This measure is however indifferent to the extent of poverty of the poor.

Alternatively, when α=1, it gives a measure called the depth of poverty (or the poverty gap). P_1 takes into account not just how many people are poor, but how poor they are on average. It is equal to the head count index (Po) multiplied by the poverty gap ratio. This index gives a good measure of the extent or intensity of poverty as it reflects how far the poor are from the poverty line. It can therefore be used to calculate the amount of income under perfect targeting that needs to be transferred to the poor in order to eradicate poverty. However the poverty gap ratio is insensitive to income distribution among the poor.

Appendix 5: Coefficients for the MNL for Land Management technologies

Variable	Fallow		Organic Fert		Inorganic Fert		Terracing		Terracing+SFM	
	Coefficient	P-Level	Coefficient	P-Level	Coefficient	P-Level	Coefficient	P-Level	Coefficient	P-Level
Sex	0.7332***	0.0000	0.3375	0.1060	-0.6018*	0.0710	1.6857***	0.0040	0.2802	0.2170
Bequeath	0.3691**	0.0260	0.8264***	0.0010	-0.4394	0.1030	0.2935	0.3030	0.1409	0.5910
Dist Res	0.0189	0.3610	-0.6020***	0.0020	0.0542***	0.0020	0.0116	0.5390	0.0186	0.2640
Dist MKT	0.0627***	0.0060	0.0167	0.6130	-0.2494***	0.0020	0.0247	0.5340	0.0936***	0.0000
Nutrient prob.	0.1891	0.1270	0.1646	0.2830	-0.2495	0.3150	-0.1150	0.6360	-0.1989	0.3440
Non-farm inc.	0.2527***	0.0000	-0.1735*	0.0570	-0.4028***	0.0040	-1.9036***	0.0040	-0.7792**	0.0280
Agric extension	0.0744	0.6130	0.1841	0.2870	0.8266***	0.0020	0.4808**	0.0630	-0.3181	0.2610
Age of hh head	0.0116**	0.0300	-0.0093	0.1500	-0.0340**	0.0120	-0.0110	0.2270	0.0093	0.4410
Educ of hh head	0.0026	0.9060	0.0099	0.6790	-0.0333	0.3130	-0.0625**	0.0960	0.0285	0.4950
Hh size	-0.0592**	0.0440	0.1007***	0.0060	0.3160***	0.0000	0.0465	0.4050	-0.0258	0.6880
Poverty	1.1264**	0.0490	-2.2153***	0.0010	-5.0289***	0.0000	-0.2077	0.8220	-1.4784	0.1420
Livestock	-0.0060	0.6630	-0.0135	0.4340	-0.0159	0.6700	0.0259**	0.0310	-0.0178	0.3350
Number of parc	0.1456***	0.0000	-0.0613**	0.0480	0.1491***	0.0000	0.1876***	0.0000	0.1722***	0.0000
Agro-climate	-1.6964***	0.0000	0.1963	0.5050	-3.1552***	0.0000	0.9394	0.1240	-0.7580*	0.0520
Mambo. to pdn org	0.2959**	0.0380	0.0111	0.9500	0.5702**	0.0360	0.5471**	0.0300	-0.0669	0.7750
Constant	-2.8562***	0.0000	-1.3879**	0.0420	2.4853**	0.0370	-5.4611***	0.0000	-2.3167**	0.0210
Number of obs =2110; LR chi2 (75) =661.02; Prob > chi2=0.0000; Log likelihood = -2378.99; Pseudo R2 = 0.1290										

SFM = Soil Fertility Management; Non-adopters are used as the base category. *, **, and *** represent the level of significance at 10, 5 and 1 percent respectively

Appendix 6: Second Stage Determinants of Poverty by group membership

	Model 1=membership in production institutions				Model 2=membership in Social service institutions			
	2SPLS		2SPLS with Bootstrapped errors		2SPLS		2SPLS with Bootstrapped errors	
Variable	**Coef.**	**P-level**	**Coef.**	**P-level**	**Coef.**	**P-level**	**Coef.**	**P-level**
Social capital	1.4167*	0.0520	1.4167*	0.0520	-0.4771***	0.0000	-0.4771***	0.0000
Education	0.0339	0.7590	0.0339	0.7670	0.1967***	0.0000	0.1967***	0.0000
HH-size	-0.3816***	0.0000	-0.3816***	0.0000	-0.4080***	0.0000	-0.4080***	0.0000
HH-age	0.3643***	0.0000	0.3643***	0.0000	0.4194***	0.0000	0.4194***	0.0000
Dist S. Road	-0.0177*	0.0690	-0.0177	0.1560	-0.0022	0.8410	-0.0022	0.8580
Non-Farm Inc.	-0.0063	0.6930	-0.0063	0.6570	0.0129	0.1640	0.0129	0.2180
Livestock	-0.0114	0.6890	-0.0114	0.6950	0.0270***	0.0090	0.0270**	0.0150
Sex	0.1375	0.1420	0.1375	0.1990	0.0742	0.1430	0.0742	0.1660
Agro-ecology	0.1928***	0.0000	0.1928***	0.0000	0.1943***	0.0000	0.1943***	0.0000
Extension	0.0905***	0.0040	0.0905**	0.0140	0.0918***	0.0030	0.0918**	0.0120
Farm size	0.0219***	0.0090	0.0219***	0.0030	0.0194**	0.0200	0.0194**	0.0100
Origin of ins.	-0.0118	0.7130	-0.0118	0.6980	0.0064	0.8430	0.0064	0.8420
Constant	8.3050***	0.0000	8.3050***	0.0000	8.6353***	0.0000	8.6353***	0.0000
Regression Diagnostics								
Number of Obs.		1695		1695		1695		1695
R-Squared		0.1577		0.1577		0.1619		0.1619
Prob > F/ Prob > Chi2		0.0000		0.0000		0.0000		0.0000
Replications		---------		100		---------		100

Notes: *, **, and *** represent the level of significance at 10, 5 and 1 percent respectively

Appendix 7: Second Stage determinants of group participation by group type

	Model 1=membership in production institutions				Model 2=membership in social service institutions			
	2SPLS		2SCML		2SPLS		2SCML	
Variable	**Coef.**	**P-level**	**Coef.**	**P-level**	**Coef.**	**P-level**	**Coef.**	**P-level**
HH-Expend	0.0945	0.5560	0.0944	0.5570	1.1305***	0.0000	1.1312***	0.0000
Education	0.4392***	0.0000	0.4369***	0.0000	-0.5880***	0.0000	-0.5895***	0.0000
HH-age	-0.0937	0.4280	-0.0924	0.4340	0.1166	0.3110	0.1175	0.3080
Non-Farm Inc.	0.0525**	0.0120	0.0527**	0.0110	-0.0666***	0.0020	-0.0666***	0.0020
Livestock	0.1141***	0.0000	0.1143***	0.0000	-0.1192***	0.0000	-0.1194***	0.0000
Sex	-0.2466**	0.0280	-0.2550**	0.0230	0.6847***	0.0000	0.6807***	0.0000
Extension	-0.0700	0.3270	-0.0687	0.3360	0.0292	0.6820	0.0299	0.6750
Ethnic Dom	0.2667	0.3270	0.2728	0.3170	-0.7324***	0.0060	-0.7352***	0.0060
Dist S. Road	-0.0153	0.4690	-0.0152	0.4710	0.1697***	0.0000	0.1698***	0.0000
Marital status	0.0595	0.1840	0.0536	0.2360	-0.0222	0.6210	-0.0251	0.5810
Constant	-1.8659	0.2110	-1.8498	0.2150	-11.0240***	0.0000	-11.0190***	0.0000
Regression Diagnostics								
Number of Obs	1695		1695		1695		1695	
Log likelihood	-1025.9702		-1025.5606		-1017.405		-1017.3231	
LR chi2(10)	118.10		118.92		204.15		204.32	
Prob > chi2	0.0000		0.0000		0.0000		0.0000	
Wald Test of exogeneity								
Chi2(1)			0.06				42.09	
Prob > chi2			0.8009				0.0000	

Notes: *, **, and *** represent the level of significance at 10, 5 and 1 percent respectively