LAND DEGRADATION

IN

UGANDA:

ITS EXTENT AND IMPACT

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Preface

This paper is part of a series of case studies, which attempt on a pilot country basis to examine the costs of land degradation. This stage of the work involves a desk analysis of:

- Impacts of land degradation
- Costs of land degradation
- Costs of land improvement measures
- Costs of policy reform and institutional development.

In general there is reasonable, though not comprehensive, information on the impacts of land degradation and a good assessment base of the proximate and root causes. Linkages with poverty are well established and the cost of current remedial programs can be identified.

There is much less information on the impact on the ground of these actions. It is clear that the impact of land degradation is a drain on economic growth in rural areas and has an affect on national economic growth patterns. Investment in remedial action is hard to quantify, but appears an order of magnitude smaller than the scope of the problem. Actual in country joint assessment with national stakeholders will be necessary to provide specific analysis of the countries concerned.

LAND DEGRADATION IN UGANDA: ITS EXTENT AND IMPACT

Executive Summary

Despite the fact that Uganda has a large percentage of arable land, soil degradation is a substantial problem in the country. Generally it is estimated that 4% - 12% of GNP is lost from environmental degradation 85% of this from soil erosion, nutrient loss and changes in crops. The worst affected areas include highland areas in the southwest and some dryland districts. There has been relatively little national scale analysis of the cost of land degradation to the national economy, but the extent of the problem is documented in detailed studies of land use change, which show declining fertility, particularly on fields away from the homestead. Percentages of land affected by land degradation range from 90% in Kabale to 20% in Masindi.

There are good national environmental plans in Uganda, but at present poorly developed institutional structures to implement those plans in the most affected areas.

LAND DEGRADATION IN UGANDA: ITS EXTENT AND IMPACT

INTRODUCTION

Uganda is in the comparatively enviable position of having a large percentage of its land arable, and much of that not yet under cultivation. Approximately 75 percent of the country's land is relatively fertile and receives sufficient rainfall for rainfed cropping or pasture. Only around 30 percent of the arable land is currently under cultivation (Zake et al. 1999). The agricultural population is relatively concentrated in Eastern, Southern and Western Uganda, and zones within those areas have very high population densities. In several regions, important signs of soil degradation trends are apparent including declining yields and a switch to crops that demand fewer nutrients. Indeed, food production has not kept up with the country's population growth increase despite an expansion of area under crops. Per capita food production hit a low in 1980, and even with recent increases it has not reached the levels of the 1970's (NEMA 2001).

The expansion of area under cultivation has been primarily due to short and medium-distance migration and conversion of wetlands, grasslands and forests to crops. This has come at the price of some environmental problems. With peace and security, new longer distance migration can be expected with an increase of land under crops greatly expanding. Arable land per capita is expected to decline from 1.1 ha in 1991 to 0.6 ha in 2015 (NEMA 2001). Meanwhile, it is critical to both reduce the trend of land degradation in areas already under cultivation, and to ensure sustainable land management practices to prevent degradation in the areas that will be placed under cultivation in the near future. Uganda's comparative advantage in climate and soils means that it has the potential to become an important producer of agricultural products if sustainable systems of production are implemented.

THE ECONOMIC IMPACT OF LAND DEGRADATION

The only available estimate of the economic impact of land degradation is a 1991 thesis and this continues to be cited in governmental reports (Slade and Weitz 1991; NEMA 2001). In the thesis, Slade and Weitz estimated that 4% to 12% of the national GNP was lost due to environmental degradation. Soil erosion contributed 85% and water contamination 9% of the loss, with biodiversity loss, water hyacinth and deforestation contributing the remainder. The value of the total in 1991 was in the range of $170-460 million per annum (Kazoora 2002). Current values (2003) are in the range of $230-$600 million. The lack of economic estimates of degradation is attributed to the deficiencies in the collection or dissemination of natural resources information by the relevant research institutions (Zake et al. 1999).

THE EXTENT AND IMPACT OF LAND DEGRADATION

The State of the Environment reports (1999, 2000, 2001) and other literature describes the causes and severity of land degradation in the country based on the best available knowledge but without the benefit of a national level study. The most common physical reason cited as causing land degradation is soil erosion. The NEAP of 1995 and subsequent reports have stated that most of the country has been affected by erosion. Even the relatively flat areas have experienced severe sheet and rill erosion, and the nutrient loss associated with soil erosion is identified as the cause of steady losses in soil productivity (NEAP 1995). Table 1 at the end of this report includes estimates of the percent of land area affected by erosion in selected districts. Those worst affected include the highland areas in the Southwest, Kabale and Kisoro (85%-90% affected), but also badly affected (75% - 80%) include Mbale, Rakai and Kotido cattle grazing districts. Some dryland districts (Moroto and Nakasongola, and Kakuuto county in Rakai) are said to be facing desertification (NEMA 2001). A summary of research on erosion and other agronomic research can be found in Nakileza and Nsubuga (1999).

In addition to the loss of land productivity, the siltation of lakes and rivers associated with erosion is leading to problems of eutrophication and reductions of fish populations. This problem is severe where former wetlands adjacent to lakes and rivers have been converted to cropping. Severely affected areas include Manafa, Kafu, Nyamwamba and the Nile River (NEAP 1995). Lake Victoria is also experiencing heavy sedimentation along its shores.

Agricultural productivity is low in Uganda in general, with wide gaps between output per hectare produced on experimental plots and what the average Ugandan farmers harvests. Bashaasha *et al*. cite a report from Ohio State University that actual yields as a percentage of potential levels are 51% for maize, 68% for soybeans, and 55% for sunflowers. The low yields are attributed to a lack of yield-enhancing investments from improved science and technology that would come from agricultural research (Bashaasha et al. 2001). Other factors that have delayed intensification include the under-development of regional markets that would permit trade of commodities between regions, a labor constraint on many farms being exasperated by the HIV-AIDS crisis and other illnesses, and inadequate government services including health care and agricultural extension (NEMA 2001).

The importance of land degradation against this backdrop of relatively low yields can be illustrated by examining banana production. Together, cooking, fruit and beer banana varieties are the most important food crop in Uganda, and occupy the largest area under food crops. Most farmers in Central, Southern and Southwest Uganda produce bananas. Indeed, Uganda is the world's largest producer and consumer of bananas. Banana production, however, has been stagnating over the past two to three decades with declines in outputs and yields. Any increases in production have come due to an expansion of area under production. The traditional center of banana production, Mpigi and Mukono districts in Central Uganda, has been experiencing declining yields and farmers are switching to cassava and sweet potatoes. Meanwhile, banana production is moving towards new land opening up in the West (Zake et al. 1999).

PROXIMATE AND ROOT CAUSES OF LAND DEGRADATION

The socioeconomic reasons for land degradation and low productivity on small-scale farms nationally have been summarized as:

1. Poverty and land fragmentation leading to over-exploitation of the land with inadequate soil and water conservation practices,
2. Increasing rural population densities with few non-farm income opportunities,
3. Low levels of commodity trade and the production of lower value commodities, reducing incentives to invest in the soil,
4. Little farmer knowledge of improved agricultural technologies, insufficient agricultural research that takes into account the needs and resource constraints of farmers, and a lack of effective agricultural extension, and

5. Inappropriate farming practices/ systems including deforestation, bush burning and overgrazing (Olson 1998; Zake et al. 1999; NEMA 2001; Kazoora 2002).

The land under crops in Uganda is being cultivated primarily by small-scale farmers, with an average farm size of 2.5 ha (Zake et al. 1999). Approximately 80 percent of the country's population lives in rural areas and depends on agro-pastoralism for its food and income (NEMA 2001). The farms and often the individual fields are commonly divided amongst the sons as land is inherited, leading to increasing fragmentation of land holdings. The farmers are mostly poor, with few resources and numerous production constraints leading to low yields. Women and children conduct most of the agricultural labor by using simple hand tools.

Labor and capital resources available at the household level to invest in soil maintenance and management remain limiting. The middle income and poorer farmers in particular cannot afford to hire agricultural labor, and inputs such as manure and fertilizers are usually not available or not cost effective in the short term. Indeed, chemical fertilizer use declined ten fold between 1962 and 1980 to almost zero except in large estates. Between 1990 and 1995, only 6,000 tons of fertilizers were imported into the country (none are produced locally) and most of that was used on the estates (Zake et al. 1999). Even in projects providing micro-finance for agriculture, small-scale farmers have not used the credit to purchase fertilizer (Akello 2002).

Agricultural commercialization has grown rapidly from a very small base since the 1980's as the national economy has grown and as the market was liberalized. As commercialization increases in importance, the value of productive land and incentives to increase yields will eventually increase. Up to now, however, areas with higher market access have been associated with higher agricultural intensification but declining yields, suggesting nutrient depletion (Nkonya et al. 2002). An analysis of regional market integration of maize (Rashid 2002), a food crop increasing in relative importance in Uganda, concluded that since the recent liberalization of the market, market integration has generally improved especially in Masaka and Mbarara. The prime markets are Kamapala and Jinja. The Northern districts, in comparison, did not experience increasing integration and even suffered a decline, reflecting a worsening of the poverty situation linked to insecurities and/or perhaps trade across the border. Other studies concluded that elsewhere in the country, greater market access was associated with more income from bananas, higher manure application on bananas, more bean production, more use of fertilizer and improved fallow, and more investment in woodlots. In general, access to roads was associated with production of higher value commodities and fewer cattle, but with declining yields (Nkonya et al. 2002; Pender 2002).

Programs providing information on land management technologies have not necessarily lead to their adoption, probably due to the their limited profitability in the present economic situation, but in general extension was associated with higher use of soil inputs and other technologies (Jagger and Pender 2002). Most farmers, however, do not have contact with extension agents or other technical assistance programs (Pender 2002).

Insecure or counter-productive land tenure systems have also been blamed for poor land management and land degradation (NEAP 1995). Reforms to land management policies to address those and other issues include major national land tenure policy changes in 1975 and 1998, the implementation of the NEAP, and the recent decentralization of governmental authority. Boundaries of protected areas, for example, have regularly been changed, and former communal grazing land has been modified to more restricted access (Bashaasha 1998; Mugisha

2002; Tukahirwa 2002). Some studies have found, however, that the impact of tenure systems on land management has mixed or limited results (Nkonya et al. 2002). The implementation on the ground of many of the recent regulations concerning soil and water conservation and other land degradation mitigation practices is not yet fully in place.

The two most fragile ecosystems in the country are the highlands and the drylands. The problems of these two ecosystems will therefore be examined in more detail in this report. Other regions, with very different agro-ecologies and land management systems, are also experiencing various degrees of land degradation processes (see Table 2).

Highland Areas

The highlands occupy around 25 percent of the country's land area and contain 40 percent of the country's population. They are found in the Southwestern, Eastern, Western and Northeastern regions. Those with steep slopes, such as Kabale, Kisoro, Bundibugyo, Mbale and Kapchorwa, are the most seriously affected by erosion. Population densities are, in general, high in these areas and most land, including marginal lands, are under cultivation. There is as yet little evidence that the increases in population densities have led to sufficient adoption of land management practices to offset worsening erosion and nutrient depletion (Nkonya et al. 2002).

Kabale

Many aspects of the Kabale agro-ecosystem are similar to other highlands in Uganda. Kabale is a highland area in the Southwest with steep slopes, intensely cropped hillsides and high population densities. Erosion and consequent soil degradation have been assumed to be a major problem since before independence (Carswell 2002), and that assumption continues today (NEIC 1994; Kazoora 2002). The region has experienced out-migration for many years due to the scarcity of land. Several researchers have examined the extent and impact of erosion in the district (Bagoora 1988; Tukahirwa 1995). The erosion measurement results vary greatly, but it appears that the soils of Kabale are stable and have high infiltration rates, leading to less than expected but still significant soil loss.

The economic impact of the erosion and land degradation have not been estimated, but model results based on measurements and farmer perceptions of productivity decline by Ellis-Jones and Tengberg (2002) indicated that the relationship of soil loss and yield decline for Acrisols has a negative exponential form, though results varied by soils and management types. On Ferralsols and Acrisols, cultivation without soil and water conservation can lead to critical losses of production even on moderate slopes after one to four years. The model results also indicated that good soil cover was the most important factor reducing yield loss. Farmers traditionally have used trash lines (lines of crop residues and weeds placed along the contour), and these are indeed beneficial. However, when labor costs are taken into account it becomes uneconomical to cultivate a field after 4-5 years of cropping with trash lines, and 3-4 years without trash lines. Their study concludes that the traditionally used techniques are very important, but have inherent weaknesses and limitations that will become increasingly apparent (Ellis-Jones and Tengberg 2000).

A study of the evolution of land use, the agricultural system and soil degradation was conducted in Kabale using remote sensing, household and field surveys, and transects (Olson 1995, 1996; Breyer et al. 1997; Olson 1998). The study found that since the 1950's, almost all land that had been pasture or wetlands has been converted to cultivation, and most fields are being managed with only short (one rainy season long) fallows. The only exception is land owned by a few wealthy farmers near Kabale town who graze dairy cows on their pastured valley fields, and who leave much of their hillside land fallow. In other farms, however, fields are intensely cultivated (see Figure 1). Characteristic land management technologies employed include crop rotation, trash lines, and use of mulch on bananas.

Fragmentation of land holdings is severe. On average, 16 fields are cultivated per household, and the average household farm is 2.25 ha. Fragmentation diversifies the micro- ecologies that farmers exploit, from the hilltop to the valley, reducing their risk throughout the year and in seasons of variable rainfall. Having so many fields, however, reduces the labor and other resources farmers invest particularly in their distant hillside fields. Available organic materials, such as manure and crop residues, are placed only on fields nearest the homestead. The fields farther from the home receive no inputs but are left fallow more often. Besides being difficult to reach (many fields are over 30 minutes walking from the home), the far fields are difficult to guard against incursion by grazing cattle.

Declining fertility is worst on fields far from the homesteads, where over half of the fields are suffering from declining fertility. Another study by Briggs and Twomlow that measured the impact of biomass transfer from the far to the nearby fields also found significant yield declines in the far fields (Briggs and Twomlow 2002). In comparison, only 27 percent of fields near the homestead have declining fertility. Certain crops are being particularly affected by soil degradation. Peas are no longer producing well and are being planted less. Irish potatoes and beans are also affected, with beans now very susceptible to diseases.

Responses To Land Degradation In The Highlands

Erosion control bunds had been installed by the colonial administration in Kabale and are still being maintained by farmers, but as field boundary markers rather than as structures to prevent erosion. Farmers perceive their lack of ability to fallow to be a more important reason for declining fertility than erosion, though they do regret the loss of good topsoil from their fields being deposited onto the fields below owned by other farmers. The owners of the above and below fields share the topsoil collected behind the bunds when the bunds are cut down. This regular practice reduces the attraction of placing more long-term erosion control devices such as grass lines or hedgerows of agroforestry species. As the system intensifies, however, the fodder production and soil fertility benefits of such practices should increase relative to their labor costs.

Production constraints are important for all but the wealthiest of households. The use of soil inputs, such as chemical fertilizers and manure, was at a very low level in the mid-1990’s. Indeed, no farmer reported using chemical fertilizers and only half applied manure to any field. This low level of input use may be due to low levels of agricultural intensification related to slowly emerging crop commercialization and agricultural extension. The labor and cash costs of inputs were not yet remunerative. Fallowing was practiced especially by the wealthiest group of farmers, with others able to leave a field fallow for at most 6 months. Declining soil fertility is a problem experienced on the fields of the poor and medium sized farms. Despite the high population densities, labor is an important constraint to further agricultural intensification especially in the poor households where the husbands are usually absent. There is, generally, a high level of dependence on women and children for agricultural labor.

Dryland Areas

The second most fragile ecosystem in Uganda, after the highlands, is the dryland areas of livestock production. The "Cattle Corridor," the rangelands from Moroto and Kotido in the Northeast though Luwero and south to Masaka and Mbarara, covers a large extent of the country. The drylands are a fragile resource, with low and unreliable rainfall and sparse vegetation.

Except in the North, much of the Corridor is considered over-stocked and seriously degraded, with problems of de-vegetation and compaction leading to erosion. Gully erosion is especially visible. Desertification is already pronounced in Karamoja and Nakasongola districts, and Kakuto County in Rakai district (NEMA 2001). Bush burning during the dry season also leads to important wind erosion, especially in the eastern districts of Kumi, Soroti, Katakwi, Moroto and Kotido. In general, the extent and frequency of xerophytic species has expanded due to the soil degradation, leading to a decline in forage quality (Zake et al. 1999). The semi-arid areas considered severely affected by both water and wind erosion include Karamoja, Soroti, Katakwi, Mbarara, Rakai and North Luwero.

The land tenure of most of the rangelands is communal, with communal grazing on natural pasture. Major socioeconomic changes are occurring in the drylands to affect this system, however, including increasing human population density and in-migration by agricultural settlers. While the human population has been increasing at a rapid rate, doubling from the 1930's to 1960's, the cattle population has increased at a slower rate. The increase in both populations is placing pressure on the land with intensive degradation occurring especially at watering points, along livestock paths and on hilltops. Areas particularly affected by over utilization include counties in Mbarara and Rakai districts (NEMA 2001).

While small-scale herders own most of the country's livestock, private or government large-scale commercial ranches own approximately 30%. Many ranches are currently being either reduced in size or privatized.

Other changes include the fencing of newly privated, formally communal grazing lands, such as in Rakai district. This is causing a concentration of livestock that had previously grazed on those lands, and severe sheet erosion on hillsides. Similarly, a large land area in Kotido and Moroto districts where the Karimojong graze their huge herds of cattle is being stressed due to the reduction of mobility of the formerly nomadic pastoralists following the imposition of administrative boundaries, security problems and increasingly frequent droughts. The area is experiencing concentration of cattle and severe degradation including invasion of unpalatable forage species and soil erosion (NEMA 2001).

Summary studies have been recently conducted of changing land management and perceptions of land degradation in agricultural zones in semi-arid Uganda (Nakileza and Nsuguga 1999; Okubal and Makumbi 2000). The authors conclude that farmers are aware of the degradation, especially that caused by erosion and declining soil fertility, but that tackling the problem would require both additional technological or agronomic research, and a multi-sectoral and interdisciplinary approach. Research in Mbarara by Tumuhairwe and others, for example, has taken a participatory approach to developing improved soil and water conservation practices in cultivated areas. Research in Toroma in the Northeast (Okubal and Makumbi 2000) concluded that the broader socioeconomic context, including the recent history of social and economic upheaval, and current livelihood insecurity, strongly affects farmers' ability and interest in investing in their land. Farmers perceive flooding and drought to be the major environmental problems they face, with only 10% of farmers mentioned erosion as being a problem. The decline of cotton growing has meant that most crop production is destined for household consumption or local trading at relatively low prices, reducing incentives to invest in soil and water conservation. Cattle production, which had started to replace cotton as the major income source, declined with insurgencies and cattle raids. New laws and regulations on land management are not yet having much effect, partly due to a weak local government.

LAND DEGRADATION MITIGATION

Ugandan, regional (AFRENA) and international institutions such as ICRAF and TSBF have found that the most promising and profitable technological option for improving soil productivity is using a combination of organic and inorganic fertilizers, with erosion control measures where necessary. Sources for organic materials include manure, coffee husks and other crop residues. Improved management of existing organic sources, such as methods integrating manure and composting, may significantly increase soil organic matter and reduce nutrient loss (Briggs and Twomlow 2002). Other sources of organic materials include legume cover crops, useful especially where population densities are intermediate and fallow is still practiced. They can produce high quality fodder as well as green manure and other soil enhancing properties. A rotation with *mucuna* (velvet bean) earned higher returns than with fertilizer for some areas in Eastern Uganda (Pender 2002). Ground cover has been found to be critical to reduce erosion and fertility losses associated with erosion.

The soils of Uganda are generally deficient in phosphorus, and increasing this mineral through biomass transfer or applying rock phosphate improves productivity. Some biomass, such as *Tithonia diversifolia*, has been found to be of very high quality, and it increases P and soil productivity after being transferred directly onto fields or incorporated into compost (Delve and Ramisch 2002). Combing *T. diversifolia* with rock phosphate produced the highest yields, though *T. diversifolia* use alone was most profitable (Pender 2002). Phosphorus rock is available in Tororo near Sukulu rock and Mbale near Busumbu rock. Use of the rock in nearby areas, especially combined with nitrogen fixating legumes, has shown promising results (Zake et al. 1999).

Analyses of the costs and benefits of various technologies to farmers, especially in land and/or labor constrained regions, are important in developing the technologies. In Eastern Uganda, it was found that investment in some technologies was only profitable after the soil had been depleted of nutrients, but that for maize they were profitable only in areas of higher rainfall and better soils (Pender 2002). Farmers in areas where *T. diversifolia* was tested innovated and adapted the technology to their own requirements, but the higher labor costs in particular would probably need to be met by returns from high value crops (Delve and Ramisch 2002). As market integration improves, the economics of investing in these technologies will change. Improving the farmer-researcher-extension-farmer linkages through participatory research is critical. The variability between farmers and households that affect resource constraints and influence adoption of technologies, including wealth and gender, also need to be considered.

Semi-arid areas have received much less attention by researchers and have additional research needs including water harvesting, storage and use methods, and improved integration of crop and livestock production. The processing and marketing of commodities produced in semi-arid areas, and infrastructure development, would also benefit from additional research.

Table 1. Estimates of the Proportion of Land Area Affected by Soil Erosion in Selected Districts (cited in NEMA 2001)

	District	Total Land Area (ha)	Estimated Area Affected by Soil Erosions		Population Density (Pple/Sq km)	Main Causes of Soil Erosion
			(Ha)	(%)		
1.	Kabale	165,300	148,770	90	250	Slopes, population pressure, deforestation, poor farming, vulnerable soil
2.	Kisoro	66,200	56,270	85	279	Slopes, population pressure, deforestation, poor farming, vulnerable soil
3.	Mbale	250,400	200,320	80	282	Slopes, population pressure, deforestation, poor farming, vulnerable soil
4.	Rakai	388,900	311,120	80	98	Vulnerable soils, poor farming, overgrazing
5.	Kotido	1,320,800	990,600	75	14	Overgrazing, bush burning, vulnerable soils
6.	Kasese	272,400	163,440	60	126	Slopes, vulnerable soils population pressure, overgrazing, poor farming
7.	Nebbi	278,100	166,860	60	114	Slopes, vulnerable soils, deforestation, population pressure
8.	Moroto	1,411,300	846,780	60	12	Overgrazing, bush burning, vulnerable soils
9.	Masaka	551,800	275,900	50	151	Slopes, population pressure, vulnerable soils, poor farming
10.	Mbarara	1,058,700	529,350	50	88	Deforestation, bush burning, overgrazing, poor farming, vulnerable soils
11.	Bundibugyo	209,700	83,880	40	55	Slopes, population pressure, deforestation, poor farming, vulnerable soils
12.	Luwero	853,900	341,560	40	53	Overgrazing, bush burning, vulnerable soils
13.	Rukungiri	258,400	77,520	30	150	Slopes, population pressure, deforestation, vulnerable soils
14.	Kapchorwa	173,800	52,140	30	67	Slopes, deforestation, poor farming
15.	Mpigi	448,600	112,150	25	204	Overgrazing, bush burning, vulnerable soils
16.	Arua	759,500	151,900	20	82	Slopes, vulnerable soils, population pressure, overgrazing, poor farming
17.	Bushenyi	490,600	981,200	20	149	Slopes, vulnerable soils, deforestation, population pressure, overgrazing
18.	Kabarole	810,900	162,180	20	91	Overgrazing, vulnerable soils, poor farming, deforestation
19.	Masindi (Rift Valley)	845,200	169,090	20	33	Vulnerable soils, bush burning, vulnerable soils

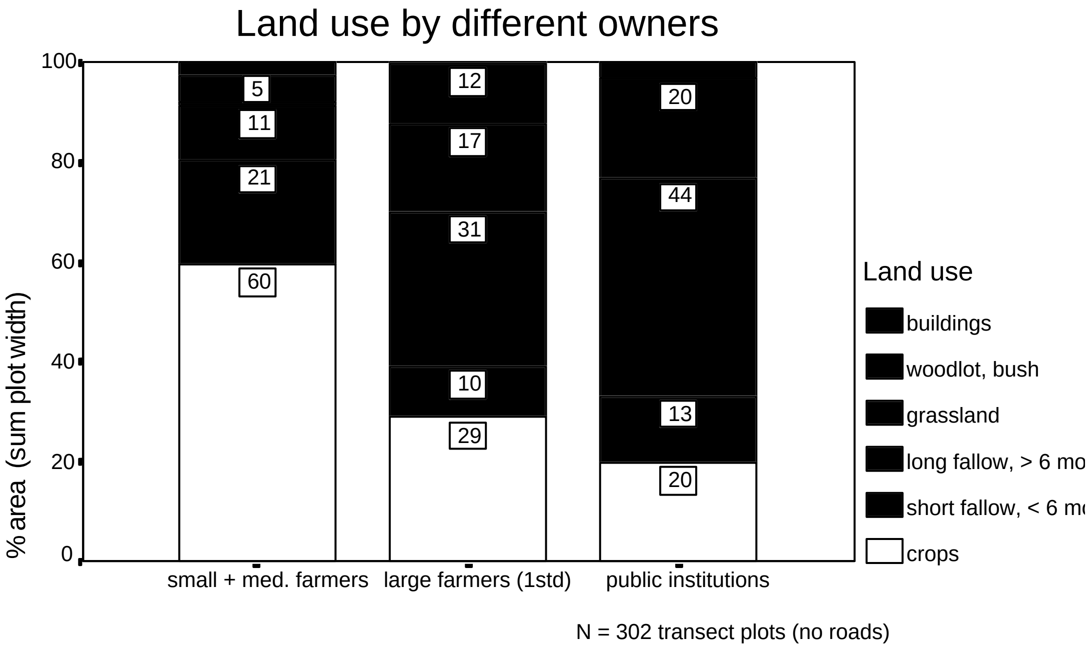
Source MAAIF

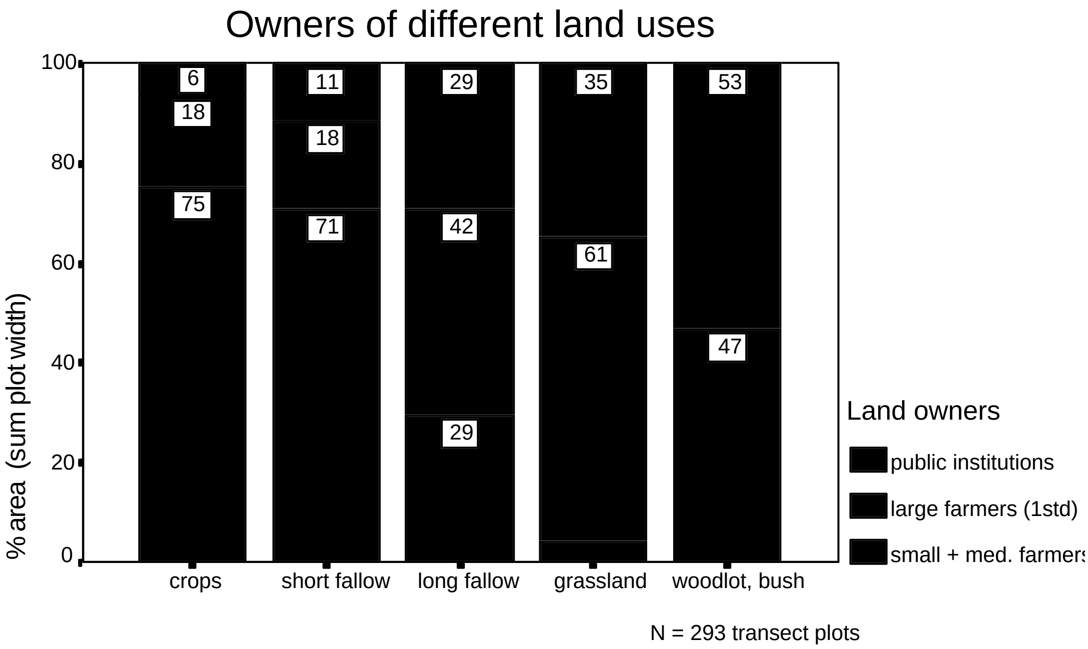
Table 2. Land Degradation Challenges by Farming System (cited in Akello 2002)

Farming system	Area	Land degradation challenges
Intensive-banana coffee system	Shores north of Lake Victoria, Mukono, south-east Mubende, southern Luwero, Ssese Islands, Kampala and Entebbe, Jinja, Iganga, Mpigi, south Kamuli and eastern Masaka and Rakai	Perennial crops and intercropping though advantageous has not stopped soil degradation due to continuous use of small plots that do not benefit from restorative measures; *mailo* land tenure system
Western banana-coffee-cattle	Bushenyi, Kabale, Rukungiri and parts of Mbarara	Highly fragmented land holdings due to population pressure; alarming deforestation, poor farming practices and steep slopes resulting in soil erosion; customary land tenure
Kigezi Afro-montane (Southwest highlands)	High altitude areas in Kabale and Kisoro as well as the northern slopes of the Muhavura Mts.	Soil fertility is dwindling fast; land fragmentation increasing due to population pressure; contour bunding increasingly eroded for more farmland therefore increased soil erosion leading to land slides
Northern and eastern cereal-cotton-cattle	Apac, Gulu, Kumi, Tororo, Soroti and some parts of Mbale	High wind and water erosion; bunding and fallowing virtually abandoned
West Nile cereal-cassava-tobacco	Arua, Nebbi, Moyo, Adjumani, Yumbe	Declining soil fertility; increased soil erosion

Source: http://easd.org.za/Soe/Uganda/CHAP3.htm

Figure 1. Land Use of Fields by Farm Size in Kabale District (source: Olson 1996).





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Annex 1. Excerpts/abstracts from recent documents on sustainable land management in Uganda.

1. Nutrient Losses

It is now recognized that nutrient losses from the steeply sloping hillsides of the tropics subtropics occur not only through soil erosion, but through the net transfer of annual crop residues to more profitable parts of the farming system. Studies of soil nutrient balances across Africa are showing evidence of widespread mining of the soil resource within the smallholder farming sector, as the organic matter and nutrient source is not replenished in annually cropped hillside fields. This paper presents information that is central to the understanding of the farming systems employed by smallholder farmers within the highlands of South West Uganda. A time static model of organic resource flows was developed with a smallholder farming community, using visible flow data from farm surveys and semi-structured interviews, to describe this situation. The model explores the sources, whereabouts and current management strategies of organic resources and defines their flow around the farming system. Results confirm a net transfer of $24 Mg ha^{-1} yr^{-1}$ ($P<0.01$) of organic material, mainly crop yields and residues, from the annually cropped hillsides (covering an area of 0.6ha per farm ($P<0.001$)) to other parts of the farming system. The stover from the annual crop is used almost exclusively as mulch in banana (Musa sp.) plantations. As a consequence, the soils on the hillsides are gradually becoming depleted of nutrients, as farmers' place little value on improving the nutrient status of hillside fields distant from homesteads. Households, as is the case with most African subsistence farmers, would rather concentrate their limited labour and organic residue resources in maintaining the fertility/productivity of the more profitable parts of the farming system, in this instance banana plantations and annual fields close to homesteads. Consequently, in the short term the perennial banana system maintains a balanced flux of organic resources at the expense of hillside soil fertility. Unfortunately, over the longer term the current system will inevitably lead to a severe reduction in mulch availability, which will mean perennial crop yields will eventually decline, leading potentially, towards an unsustainable farming system. Fortunately, however, there are under-exploited organic resources within the existing farming system, that if fully utilised and could help sustain and even improve the yields of both annual and perennial crops. The whereabouts, management and value of these organic resources need to be highlighted to farmers so that alternative management strategies for organic residues can be developed, that are both economically appropriate to the farmer and the resources available, at farm level.

Source: Briggs L.; Twomlow S.J.[1]. Organic material flows within a smallholder highland farming system of South West Uganda. Agriculture, Ecosystems and Environment, May 2002, vol. 89, no. 3, pp. 191-212(22)

[1]Silsoe Research Institute, International Development Group, Wrest Park, Silsoe, MK454HS, Beds., UK

2. Land Tenure and Land Degradation

This article provides an empirical analysis of the impact of different tenure systems (mailo, customary, and public land) on agricultural investment and productivity in central Uguanda. A major hypothesis tested is that land investments and practices may have both economic and tenure security implications. The results indicate that coffee planting is used by farmers to enhance tenure security, while fallowing is practised to a greater extent by farmers on more secure holdings. This supports the notion that farmers consider tenure implications when making investments and that different tenure systems do not inhibit the promotion of tree-planting investment. Tenure had no impact on the productivity of crop farming.

Source: Place F.; Otsuka K.. Land Tenure Systems and Their Impacts on Agricultural Investments and Productivity in Uganda. Journal of Development Studies, August 2002, vol. 38, no. 6, pp. 105-128(24)

3. Soil Organic Matter

Under continuous cultivation, nutrients in the topsoil are decreasing and soils are becoming more acidic. Under prolonged continuous cultivation conditions, total SOM level may not be enough to indicate soil fertility status, hence there is a need to identify a better indicator. To arrest the land degradation process, appropriate soil and water conservation methods to reduce nutrient losses and acidification through reduced erosion and increased use of inputs will be required. Where nutrients are leached, rotating shallow-rooted crops and deep-rooted crops/grasses or agroforestry species should be encouraged to increase recycling of leached nutrients and reverse acidification trends. For continuously cultivated soils, inputs are necessary to reduce degradation and nutrient imbalances due to losses through erosion and nutrient exports. Although the fertilizer market in Uganda is liberalized and there is no tax on fertilizers, the fertilizer market is not developed and there is a need for financing, training and information provided to dealers, stockists, farmers, extension agents, and policy makers.

This paper gives a good insight into the trend of soil fertility in selected sites in Uganda. An important finding is that soil organic carbon alone is not anymore a good indicator for soil fertility and that investments are needed in order to restore the fertility of the soils. This result will have consequences for fertilizer recommendations in Uganda.

Source: Ssali, H. Soil Organic Matter And Its Relationship To Soil Fertility Changes In Uganda, National Agricultural Research Organisation, Uganda. In Policies for Sustainable Land Management in the East African Highlands. IFPRI – ILRI. September 2002

4. Impact Of Technical Assistance Projects

We find that technical assistance programs are having substantial impact on increasing adoption of improved land management practices, yields and income of some crops (e.g. bananas), livestock incomes, incomes from other farm and non-farm activities, and reducing soil erosion. This broad set of positive outcomes suggests that "win-win-win" strategies contributing to increased agricultural productivity, reduced poverty and sustainable use of natural resources are possible. Still, the coverage of these programs is very limited, and the vast majority of farmers have not been involved in extension or training programs, especially in remote areas such as much of the eastern highlands.

This study observed that the poorest regions are the north and east, pointing to the need to target programs in these areas to address poverty problems. Specifically, our observation that areas with high market access were associated with higher agricultural intensification but declining yields of several crops suggests that nutrient depletion in such areas is a major concern. Although improved market access may increase efficiency of agricultural marketing, low profitability of outputs may limit farmers' ability to apply adequate inputs to stop the nutrient depletion. Therefore, large use of external inputs may not be a feasible option for addressing land degradation.

One of the solutions often suggested for this problem is integrated soil fertility management, which includes use of a variety of sources of nutrients and cultural practices that conserve, add or increase availability of naturally occurring nutrients. However, we observe that organic fertility sources did not show significant increases in most crop yields. This calls for increased research and extension efforts to generate and disseminate organic fertility management technologies that are acceptable to and profitable for smallholder farmers.

Education may be one of the approaches of relieving land pressure as we find that education increases the probability of farmers getting engaged in off-farm activities. However, education is associated with less adoption of labor-intensive land management practices. There is a need to include practical training in agriculture and land management in educational curricula to minimize negative impacts of education on land management.

Source: Nkonya E., Pender, J., Sserunkuuma, d., and Jaggera, P. Development Pathways and Land Management in Uganda. International Food Policy Research Institute, USA & Makerere University, Uganda. In Policies for Sustainable Land Management in the East African Highlands. IFPRI-ILRI. September 2002.

5. Importance Of Markets

Some important general themes/lessons emerge from these papers. One is the primary importance of improving markets and identifying profitable opportunities if significant progress is to occur. As argued by Woelcke et al., soil nutrient depletion is likely to continue to be a major problem in Uganda unless the profitability of agriculture substantially improves. Adoption of inorganic fertilizers and other soil fertility-enhancing technologies is predicted by Woelcke et al. to be inadequate to halt declining fertility, unless there are major increases in output prices and/or major reduction in input prices. It is not clear whether the extent of improvement in price ratios considered by Woelcke et al. is feasible, though he provides some information on marketing margins in Uganda suggesting that significant improvement should be possible.

Source: Woelcke, J., Berger, T., & Park, S. Land Improvement And Technology Diffusion In Uganda: A Bioeconomic Multi-Agent Approach. Center for Development Research, University of Bonn, Germany. In Policies for Sustainable Land Management in the East African Highlands. IFPRI – ILRI. September 2002.

6. Biological Responses

This paper examines the potential of using the velvet bean (*Mucuna pruriens*) as a way of enhancing soil fertility in Uganda. This approach for soil fertility restoration is very interesting because inorganic fertilizers are costly and not available everywhere.

The results showed that *mucuca* can fix large amounts of nitrogen and contribute to increase the productivity of the soil. The best economic return is found on the most productive soils.

Source: Kaizzi, C.K., Ssali, H., Nansamba, A., and Paul, L.G. Vlek. The Potential Benefit Of Velvet Bean (*Mucuna Pruriens*) And N-Fertilizers In Maize Production On Contrasting Soils In Uganda. National Agricultural Research Organisation, Uganda & University of Bonn, Germany. In Policies for Sustainable Land Management in the East African Highlands. IFPRI – ILRI. September 2002.

7. Summary Statement

In summary, there are many opportunities to promote improved livelihoods and land management in the East African highlands. The prospects for breaking out of the downward spiral of land degradation, low productivity and poverty are good, but the task is not simple or easy. Changes in policies, programs and institutions will be needed that are well suited to the comparative advantages of different locations, taking into account the diversity of circumstances in the East African highlands, and recognizing that the same intervention can have different impacts in different circumstances, that complementary interventions need to be bundled together to be most successful, and that trade-offs among desirable outcomes are often likely to occur. By recognizing and taking into account such realities, policy makers and development agencies will be better able to achieve results that are in line with the potential of the region and its peoples.

Source: Benin, S., Ehui, S., & Pender, J. (September 2002). Policies for Sustainable Land Management in the East African Highlands. IFPRI – ILRI. In . In Policies for Sustainable Land Management in the East African Highlands. IFPRI – ILRI. September 2002.

Annex 2. Land Degradation Projects - World Bank 2001

1. Environmental management and Capacity Building Project

The Second Environmental Management and Capacity Building Project will sustain environmental management at the national, district, and community levels, and assist the Government of Uganda (GOU) in the implementation of the National Environmental Action Plan, related National Environment Statute, and the Local Government Act. Project components are as follows. 1) The local government, and communities environmental capacity building component, will provide support to enable the fulfillment of statutory roles in decentralized environmental management. Logistical support will be provided, to build, and strengthen capacities in environmental planning, and, redress key environmental issues. The component will complement the GOU efforts to eradicate poverty, and improve living standards within the country. 2) The capacity building component will strengthen partnerships with lead agencies, within sectoral mandates as required by the National Environment Statute (1995). Critical actions, and policies by lead agencies will be identified, and, logistical support, skills development, knowledge support will be provided to enable integrated environmental policies, plans, and programs. 3) The component will consolidate the institutional structure of the National Environmental Management Authority (NEMA), ensure that capacities in regulation, and compliance are built, and promote sustainable development through awareness campaigns.

World Bank - Working Paper (2001)

2. Nile River Basin: Transboundary Environmental Analysis

This trans-boundary environmental analysis is a catalyst, a valuable resource to the riparian countries, that provide a description of the range of ecosystems within its basin rivals, and, presents and examines the required development challenges, and efforts to promote the Nile ' s sustainability. The report identifies trans-boundary environmental issues, namely, deforestation and soil erosion that can increase vulnerability to drought, leading to sedimentation and flood risks; loss, and degradation of wetlands and lakes; need for cooperative protection of key habitats; spread of invasive water weeds; and, water borne diseases - malaria, diarrhea, and bilharzia (Schistosomiasis). A program of complementary preventive, and curative actions is recommended, to address current and emerging issues, that emphasizes on stakeholder awareness, and involvement on water and environmental management, on training and education, capacity building, information sharing, and institutional development. It also reviews opportunities for mobilization of resources, to support the recommended program.