

**Land Management in Uganda: Characterization of Problems and Hypotheses
about Causes and Strategies for Improvement**

Project on Policies for Improved Land Management in Uganda

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Abstract

In this paper we review the problem of land degradation in Uganda and its causes, and consider possible strategies to achieve more sustainable development and improved land management. We find that soil fertility depletion and soil erosion are the main degradation problems in Uganda and that these problems are affected by relatively well-understood proximate causes, but by a complex set of underlying factors and policies. We present a conceptual framework to sort through this complex set of factors and argue that appropriate policy strategies for sustainable development and improved land management depend upon the pathways of development that have comparative advantage in a given location. We argue that the comparative advantage of development pathways is largely determined by three factors—agricultural potential, access to markets and population pressure. Based upon differences in these factors, we identify several development domains in Uganda, where different development pathways may be suitable. For a few of the major development domains, we identify hypotheses about the key opportunities, constraints, land management problems and options, and suggest possible priorities for development strategies in these regions.

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1. Background

In January, 1999, the International Food Policy Research Institute (IFPRI) initiated a project on “Policies for Improved Land Management in Uganda” in collaboration with the Makerere University Faculty of Agriculture (MUFA), the National Agricultural Research Organization (NARO), the Agricultural Policy Secretariat (APSEC), and the Center for Development Research of the University of Bonn (ZEF).¹ The objectives and activities of the research project were developed in a participatory planning workshop held in Kampala during January 1999, involving the collaborating organizations and other stakeholders from Uganda and international organizations. The long-term goal of the project is to contribute to improved land management in Uganda, in order to increase agricultural productivity, reduce poverty and ensure sustainable use of natural resources. The immediate purpose is to help policy makers identify and assess policy, institutional and technological strategies to improve land management in Uganda.

The research project focuses on the plateau and highlands regions of Uganda (above 1000 m.a.s.l.), excluding the lower, drier and/or more insecure parts of the country in the west, northwest, far north, and northeast.² This region represents seven of the nine major farming systems of Uganda (NEMA, 1999), and includes substantial variation in agricultural potential, market access, population density and other factors affecting development pathways and land management.

In order to achieve this purpose, several research activities were planned³, including

- characterization of land management problems in a selected region of Uganda and specification of hypotheses about key causes and possible responses; based upon review of available literature and secondary data, consultations with key officials, and field visits;
- identification of market structure, market development patterns and responses to structural adjustment policies; based upon analysis of market and trader surveys;
- identification of the main pathways of development in the selected region, their causes, and implications for land management; based upon analysis of community-level surveys and soils characterization work in selected communities;
- assessment of the impacts of policies and other factors on land management within major development pathways; based upon analysis of household and plot-level surveys and assessment of soil nutrient balances in a sub-sample of communities representing dominant development pathways; and,
- exploration of the potential impact of alternative policy, institutional and technological strategies at the farm and market level; based upon investigation of land management

¹ Financial support for the project is being provided by the German Federal Ministry for Technical Cooperation (BMZ), the Norwegian Ministry of Foreign Affairs (MFA), and IFPRI unrestricted core funds. We are grateful to these organizations for their generous support of this project.

² The districts included in the project study area include Kabale, Kisoro, Rukungiri, Bushenyi, Ntungamo, Mbarara, Rakai, Masaka, Sembabule, Kasese, Kabarole, Kibale, Mubende, Kiboga, Luwero, Mpigi, Nakasongola, Mukono, Kamuli, Jinja, Iganga, Bugiri, Busia, Tororo, Pallisa, Kumi, Soroti, Katakwi, Lira, Apac, Mbale, and Kapchorwa.

³ The project objectives, outputs, activities and work plan are described in detail in IFPRI, et al. (1999).

options at the farm level, policy and institutional options at the policy level, and development of farm-level and market-level models of agriculture and land management.

This report is based upon the first set of activities. It characterizes land management problems and identifies key hypotheses about the causes and possible solutions to these problems. It draws heavily from several papers completed by collaborators as part of this project (Ssali, 2000; Bashaasha, 2001; APSEC, 2000), as well as from field visits, literature, and other sources of information available to the authors.⁴

⁴ Any errors or omissions are, of course, the sole responsibility of the authors.

2. Introduction

Land degradation has become a major concern in Uganda, as in many other parts of sub-Saharan Africa. Although Uganda's soils were once considered to be among the most fertile in the tropics (Chenery, 1960), problems of soil nutrient depletion, erosion, and other manifestations of land degradation appear to be increasing. Stoorvogel and Smaling (1990) estimated that soil nutrient losses in Uganda were among the highest in sub-Saharan Africa in the early 1980's and predicted these rates to increase by the year 2000. A recent farm level study of nutrient depletion estimated large negative nutrient balances for most cropping systems studied in central and eastern Uganda (Wortmann and Kaizzi, 1998). Soil erosion is also reportedly a serious problem in many parts of the country, though objective evidence is limited. Bagoora (1988) found evidence of serious erosion in the southwestern highlands, though the generality of this finding has been questioned (Lindblade, et al., 1996).

Although the evidence is limited, it appears that land degradation is contributing to low agricultural productivity, unsustainable land use and poverty in Uganda. Farmers' yields of most major crops are low—typically averaging less than one-third of yields found on research stations—and for many crops have been stagnant or declining throughout much of the 1990's (Figure 1). In a survey conducted in 1992, more than half of farmers reported that the productivity of their land was declining, usually as a result of land exhaustion and poor management, with the problem especially common in forest areas and in the highlands (FAO, 1999). Banana (matooke) production has been declining in the high rainfall Lake Victoria region for the past decade and shifting to drier areas to the west, reportedly because of declining yields (Ibid.). Farmers in the densely populated southwestern highlands have been abandoning land and in some cases, leveling established conservation bunds to harvest the more fertile soil stored there (Ibid.).

Of course, many such changes may be due to factors other than land degradation. For example, pest problems and/or higher returns to cash crops may be responsible for the shift of banana production away from Lake Victoria (Gold, et al., 1999), while rising labor costs and off-farm opportunities rather than land degradation might be the cause of land abandonment in the southwestern highlands. Research is needed to establish the extent to which such changes are actually occurring, and the extent to which land degradation is responsible. Helping to establish such linkages is one of the objectives of this research program.

Research is also needed to identify the causes of land degradation (as well as improvement), where it is occurring. The proximate causes of land degradation problems are relatively well understood. For example, declining use of fallow coupled with very limited use of inorganic fertilizers or organic inputs is virtually certain to cause nutrient depletion. Annual crop production on steep slopes with limited ground cover, limited or deteriorating soil conservation investments, and intense rainfall is very likely to cause soil erosion problems. But the factors underlying these proximate causes and their implications in different circumstances are not well understood. For example, population pressure and market development are often cited as primary causes of land degradation, by promoting expansion of production on marginal lands or exploitative use of existing land. On the other hand, these factors may also promote labor-

intensive land improvement by increasing the value of land relative to labor (Tiffen, et al. 1994; Pender 1998). Many other factors may also underlie land degradation or improvement—for example, access to information and technology, poverty, access to credit, education, high costs of inputs, land tenure relationships, commercialization of agricultural production, and others—and most also have difficult to predict effects on land management.

The underlying causes of land degradation may in turn be affected by many aspects of government policy. For example, there is widespread concern that market liberalization and structural adjustment policies in Africa have contributed to soil nutrient depletion by increasing costs of imported fertilizer and reducing the presence of government input distribution, credit and extension programs. On the other hand, these policies can help promote more efficient use of scarce inputs by promoting market development and production of tradable commodities according to comparative advantage. The low degree of commercialization of agriculture is one reason small farmers in Africa have little access to credit and little ability to buy fertilizer, fuel, or feed (Ehui 1995). Many other policy factors also likely affect land management, including (among others) development of roads, irrigation, and other infrastructure; land tenure policies; agricultural credit and input supply policies; and agricultural research and technical assistance programs.

Assessing the impact of different causal factors and identifying effective policy strategies to improve land management is a critical research challenge that has not yet been solved. In part, this is due to the complexity of factors influencing the problem. It is also due to the site-specific nature of soil nutrient management (Swift 1996). Most of the factors mentioned above vary substantially from one village or household to the next (for example, population pressure, infrastructure development; degree of commercialization; access to credit, inputs, or technical assistance; land tenure relationships), as do local soil and agro-climatic conditions. In addition, the magnitude and even the direction of impacts of many causal factors may depend on particular local conditions.

Given the complexity of factors affecting land management and the diversity of local conditions in Uganda, no single technological approach or package can address all of the problems related to land degradation. Similarly, no “one-size-fits-all” policy strategy will suffice to generate sustainable development and improved land use throughout Uganda. To be sure, there are many general prerequisites for sustainable development, including peace and security, responsive and accountable government at all levels, a sound and stable macroeconomic environment, a competitive market environment, land tenure security, an environment conducive to private entrepreneurship, saving and investment, and regulation of activities affecting the natural environment where necessary. The government of Uganda has done much to address these requirements through its efforts to secure peace and security throughout the country; enactment of the 1995 Constitution, the Local Governments Act of 1997 and the ongoing process of decentralization; commitment to tight monetary and fiscal policies; exchange rate and market liberalization and privatization of state-owned enterprises; enactment of the Land Act of 1998 and the National Environmental Statute of 1995; and other policy and institutional reforms (APSEC, 2000).

Although these reforms have been successful in stimulating the process of economic growth and diversification, much remains to be done to ensure sustainable rural development in Uganda. Implementation of these policies is an ongoing process, and in many cases (e.g., implementation of decentralization, the Land Act, and environmental policies) the effectiveness and impacts of implementation will depend to a great extent on diverse local conditions. Beyond this, sustainable development and improvement in land management will require substantial investments in physical, human, natural and social capital by both public and private agents, as envisioned in the Plan for the Modernization of Agriculture. Identifying the appropriate mix of such investments, obtaining participation by the appropriate agents (both private and public, at different levels), and ensuring coordination among these different agents and investments to obtain the greatest benefit from the investments made, are major challenges ahead. To meet this challenge, appropriate development strategies are needed for the diverse circumstances of agriculture in Uganda.

The objectives of this paper are to review the available evidence about the extent of land degradation problems in Uganda, to develop hypotheses about the causes and possible responses to such problems, and to begin to identify appropriate strategies to promote sustainable development and improved land management. The suggestions will be offered as hypotheses rather than as firm conclusions, since substantial empirical research is still needed to investigate the feasibility and desirability of the suggested strategies and supporting policy and institutional interventions.

In this paper, we argue that the nature of land degradation problems and appropriate means of addressing them will depend upon the broader development pathway that is pursued.⁵ For example, in areas where commercial crop production is occurring, the potential to address soil nutrient depletion using large inputs of inorganic fertilizer will be much greater than where production is likely to remain mainly subsistence-oriented. The latter situation will require lower use of external inputs, although opportunities for integrating small amounts of purchased inputs with local sources of inputs should not be overlooked.

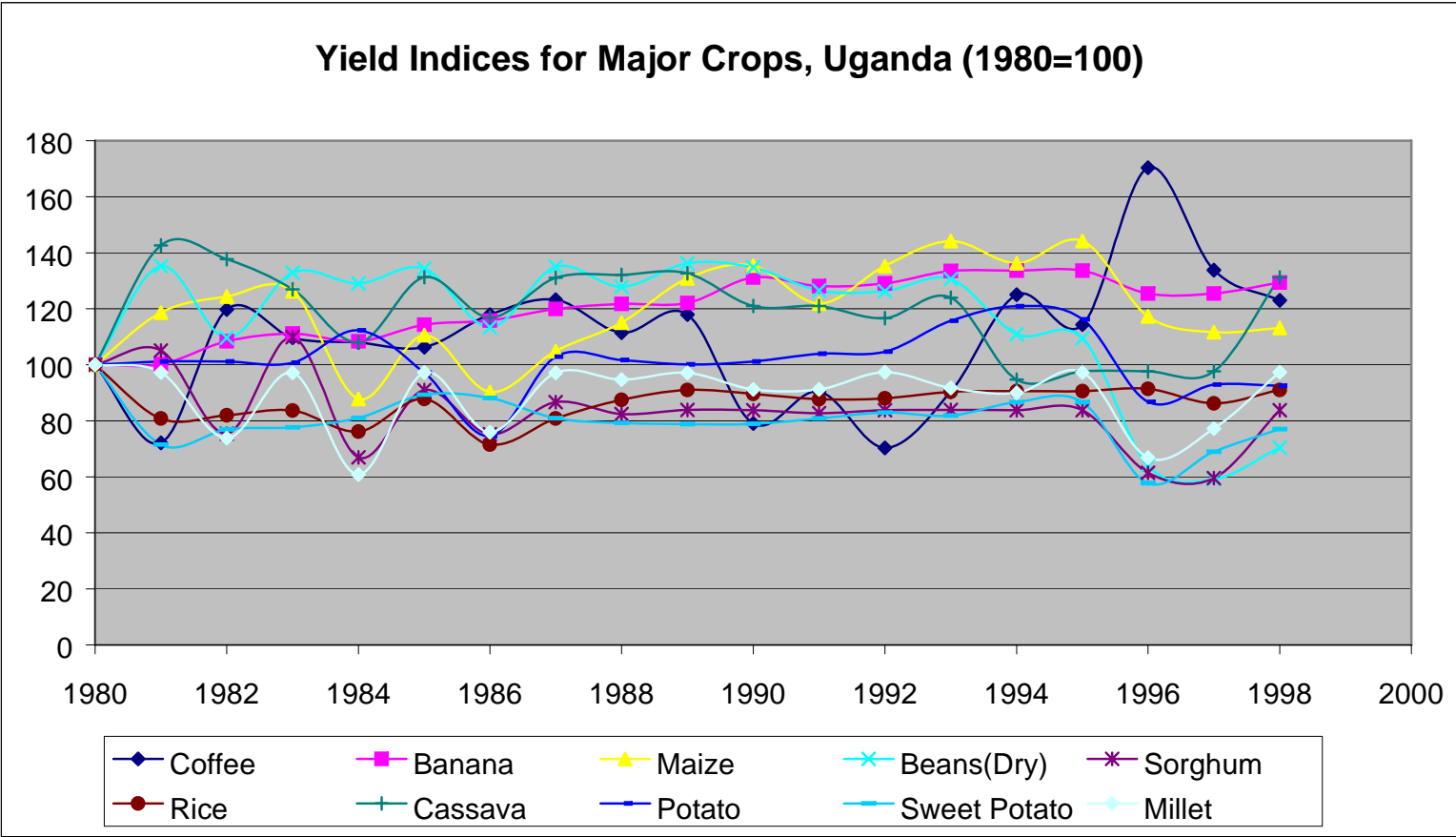
We also argue that the policy and institutional strategy, particularly the appropriate mix of public and private investments, should be linked to the pathway of development. For example, areas where a commercialization pathway is viable may require development of input and output markets through private or public investment in transportation and marketing facilities, credit, etc. Appropriately targeted and sustained research and technical assistance will be important to all strategies, but especially where a low external input (and knowledge intensive) pathway is pursued.

The appropriate development pathway depends upon the factors that determine local comparative advantage. Three factors of particular importance in this regard are agricultural potential, access to markets, and population density. Accordingly, we consider which development pathways are suited to different development domains in Uganda, representing

⁵ A “development pathway” is defined as a common pattern of change in livelihood strategies, associated with its causal and conditioning factors (Pender, et al. 1999). For example, two development pathways found in a study in central Honduras were 1) expansion of basic grains production in areas far from the urban market and roads, and 2) adoption and intensification of horticultural crops production in areas close to the urban market and roads (Ibid.).

different conditions in terms of these three variables. We conclude with hypotheses about key opportunities, constraints, land management options and development strategies appropriate to different development domains.

Figure 1



Source: FAOSTAT, 1999

3. Nature and Extent of Land Degradation in Uganda

Land degradation refers to a decline in the capacity of the land to provide valuable goods and services (including environmental services), and may refer to changes in vegetative cover or topographic features as well as physical, chemical or biological degradation of the soil (Scherr and Yadav, 1996). In this paper, we focus mainly on soil degradation, and consider de-vegetation and topographic features as proximate causes of soil degradation.

In Uganda, land degradation occurs mainly in the form of soil nutrient mining, soil erosion⁶, leaching and decline in soil physical characteristics due to compaction, water logging and surface crusting (Zake et al., 1997; NEMA, 1998).

Soil erosion

Many soil researchers in Uganda believe that soil erosion is the most important form of land degradation and the large part of the country has been affected to one extent or another. There is limited information on quantity of erosion in different parts of the country (Magunda and Tenywa (1999). However, some efforts have been made by Bagoora (1990); Zake, et al. (1995); Tukahirwa (1996); Magunda et al. (1997); and Majaliwa-Mwanjolo (1998), to quantify soil erosion using run-off plots. Results from such studies have then been extrapolated to other arable lands. The major weakness of extrapolating results of run-off plots to quantify soil erosion is their high discrepancies shown from one area to another (Magunda and Tenywa, 1999).

Some of the most affected areas are the highlands of Kabale, Kisoro, Bundibugyo, Mbale and Kapchorwa districts (Magunda and Tenywa, 1999; Zake, et al., 1997). Even in relatively flat areas such as Iganga, Kamuli, Tororo and Kumi, soil erosion has occurred at an alarming rate largely through rill and sheet erosion. In the semi-arid areas of Uganda where fragile vegetation cover has been degraded by overstocking under nomadic grazing, sheet and rill erosion are severe. The seriously affected semi-arid areas include Karamoja, Soroti, Katakwi, Mbarara, Rakai, and North Luwero. These areas suffer from both water and wind erosion. There is extensive wind erosion in Kumi, Soroti, Katakwi, Kotido, and Moroto during the dry season because soils remain exposed during prolonged dry months after the cultural practice of uncontrolled bush burning (Zake, et al., 1997).

Bekunda and Lorup (1994) assess the status of soil erosion for some of the zones in the southern part of the country. The assessment provides a detailed analysis of the status of soil erosion in southern Uganda.

⁶ Soil nutrient mining or depletion results when the inflows of nutrients to the soil through manure, inorganic fertilizers, biological nitrogen fixation, addition of wastes or plant materials from outside the system, atmospheric deposition and sedimentation are less than outflows due to crop harvesting, removal of crop residues, erosion, leaching and gaseous losses (Stoorvogel and Smaling, 1990). Soil erosion involves the loss of fine particles, nutrients and organic matter, and contributes to the loss of structural stability of the soil, surface compacting and sealing, reduced water infiltration and increased surface runoff.

Southwestern Mountain Region: (Kabale – Kisoro, part of Rukukingiri). Has flat-topped ridges terrain with slopes as steep as 10-40% in the upper parts and 5 – 10% in the lower parts. Approximately 50% of the area is too steep for cultivation. However, due to land pressure, virtually all available land up to 30% slope has been cultivated (Kanabahita, 1995). Major crops are annuals, which imply intensive cultivation. Soil is always bare at the onset of rainfall implying unhindered soil erosion during rainstorms. Livestock movement exacerbates the problem of soil erosion, which pulverizes the bare soils, leading to sheet and reel erosion on steep slopes. Gully erosion is found in the valleys.

Zake and Magunda (1999) report that during the colonial era, soil and water conservation were enforced in the sloping lands. The enforcement entailed a strong element of coercion, leading to significant level of resentment of the policy. Hence after independence in 1962, the policy was neglected. This neglect has led to environmental degradation, which has been compounded by the population pressure. The current population density in the area is about 300 persons per km² (Bekunda and Lorup, 1994). The terraces and contours constructed during the colonial period were destroyed. However, the mitigating factor to the worsening soil degradation in the area has been the well-drained clay-loamy soils, which reduce runoff (Tenywa and Lal, 1994). Lindblade, et al. (1996) also observed that despite population growth, fallowing has increased in some areas of Kabale. However, they do not explain why fallowing has increased.

Mount Elgon Region: This is a densely populated area with about 280 persons per km². Unlike the southwestern highlands, the Mount Elgon area is dominated by perennial crops that provide good soil cover throughout the year. The soils have high infiltration capacity hence low erodibility potential. Additionally, most of livestock are zero-grazed, implying less erosion caused by animal movement (Bekunda and Lorup, 1994). Zake et al.(1997) observe that soil fertility mining is the major cause of declining yield of plantain banana in the area.

Rwenzori Region: Though there is cultivation on the steep slopes of Mount Rwenzori in Kasese, it is not as extensive as in Kabale and Mbale owing to the lower population density. The major problem is burning of crop residue prior to onset of rainfall. This leaves the soil bare and susceptible to erosion. The common types of soil erosion in this area are sheet and reel.

Southwestern Pastoral Region: This area covers Mbarara, parts of Masaka and Rakai, Mubende and Sembabule. It receives low rainfall but is overstocked and overgrazed. This implies the region has poor vegetation. Additionally, farmers and pastoralists burn crop residues and grasses just before the on-set of rains. This leaves the soils bare and accelerates soil erosion in the region. The most common type of soil erosion in the area is sheet erosion.

Southwestern highlands: Covers the Bushenyi, Ntungamo, and Kabarole districts. This region is characterized by banana crops and well-distributed rainfall, which permit groundcover throughout the year. Livestock grazing takes place in the lowlands. These factors make the

erosion problem less severe than most of the highly populated highlands in Uganda. There are however, some localized steep slopes with serious soil erosion.

Lake Victoria Crescent Region: This area is densely populated, supporting about 7 million people. Perennial crops with good groundcover are cultivated in most areas. This protects the soils from raindrop impact as well as enhancing infiltration. Hence erosion is moderate. However, introduction of annual crops in recent years has increased soil erosion considerably (Lufafa, et al., 2000). For instance, Achan et al. (1999) observe the coffee-banana canopy provides a good cover for the soil while a banana-annual (e.g. cassava) canopy does not provide enough land cover and hence leaves the soil exposed to forces of erosion. Current estimates of soil erosion in the Lake Victoria basin are above the tolerable value of 5 tons per hectare per year (Lufafa, et al., 2000).

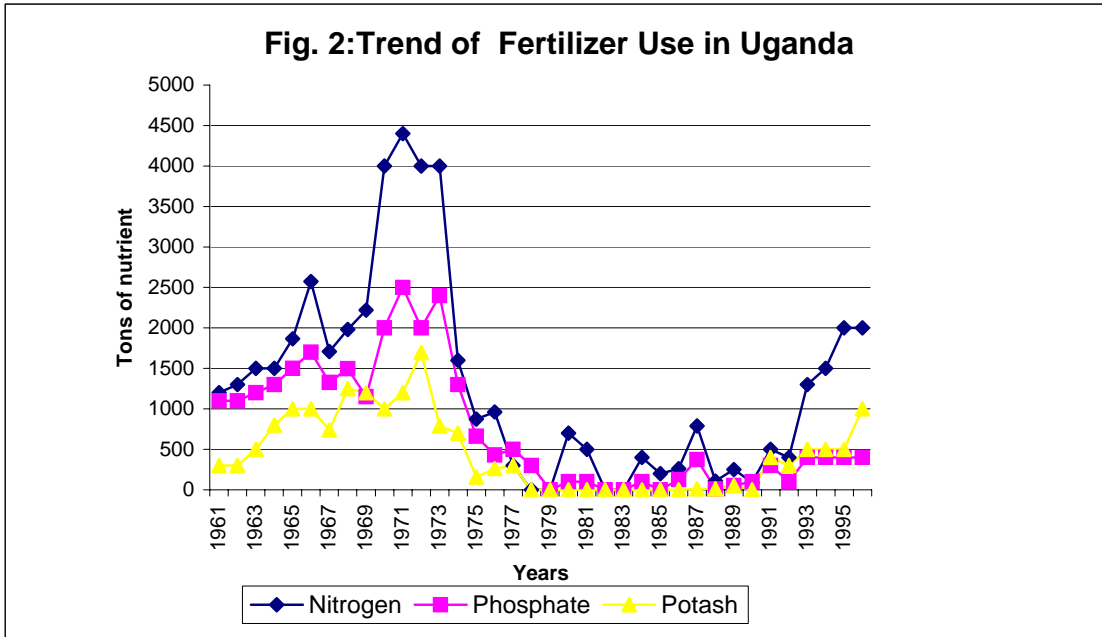
Yield of plantain banana in the region has been on the decline. Soil erosion and nutrient depletion have been cited as major reasons for the decline (Tenywa, et al., 1999).

Soil Fertility Depletion

NEMA (1998); Walaga, et al. (1999); and Zake, et al. (1997) observe that soil nutrient depletion is basically due to inappropriate or poor farming practices. Application of organic materials is limited, while inorganic fertilizer use is almost non-existent. Fertilizer use is restricted to large estates who are estimated to account for about 95% of total fertilizer consumption in Uganda (IFDC, 1999). Fertilizer use increased between 1961 – 1971 when it reached a peak. Due to political instability and other factors, fertilizer use declined sharply between 1971 to 1979 when it bottomed out (Fig. 1). Fertilizer use increased in the 1990's, but has remained low. For instance, between 1990 and 1996, Uganda imported only 6,000 tons of fertilizer (IFDC, 1999).

Stoorvogel and Smaling (1990) estimated annual soil nutrient losses in Uganda of nitrogen phosphorus and potassium of 70 kg/ha/year in 1980's and predicted that the depletion would increase to 85 kg/ha/year by the year 2000. Wortmann and Kaizzi (1998) estimated even higher nutrient depletion for most cropping systems in central and eastern Uganda.

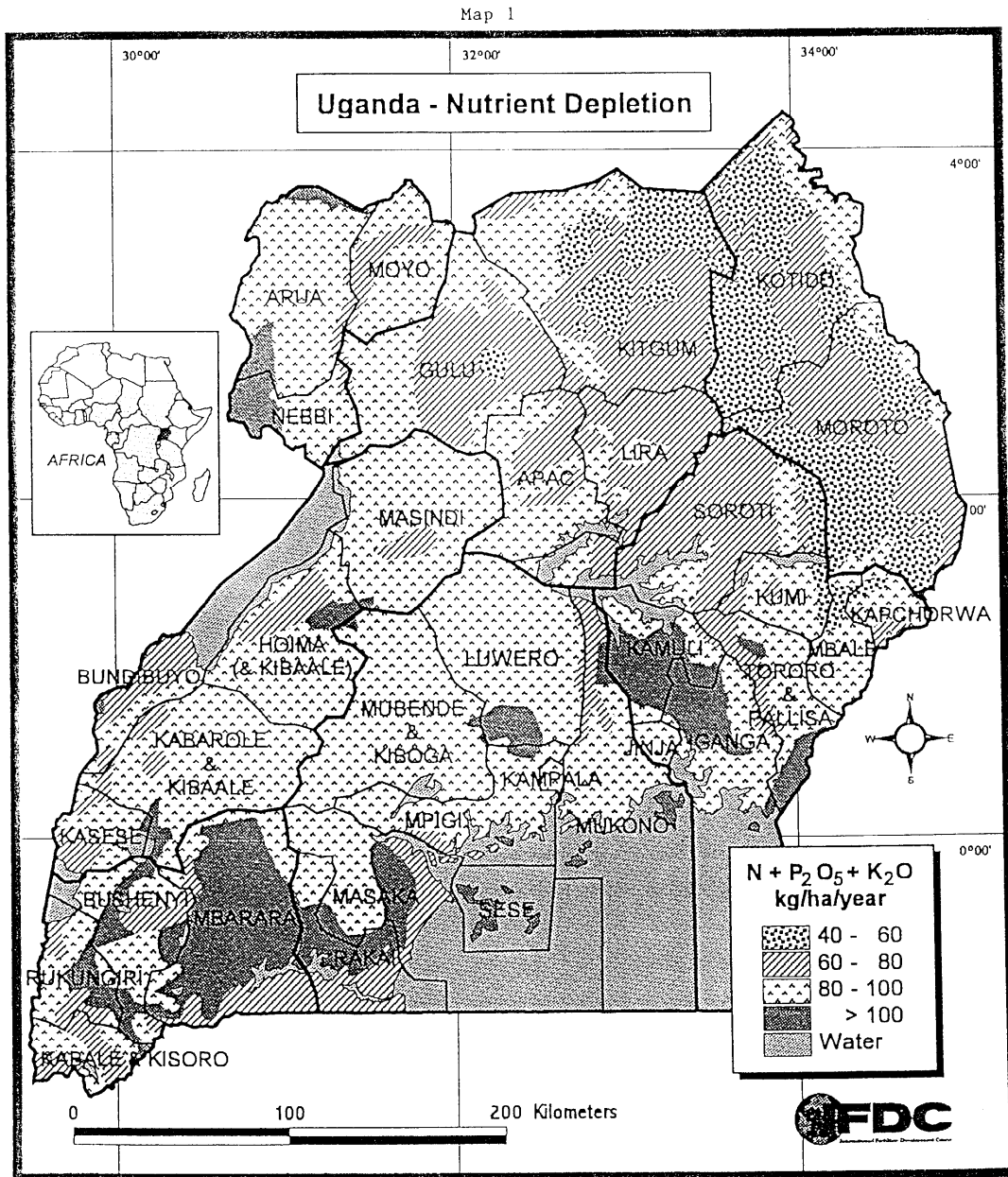
Figure 2 shows the estimated distribution of nutrient depletion in Uganda. The most severe depletion of nitrogen, phosphorus and potassium (NPK) is found in parts of Mbarara, Masaka, Kamuli, Iganga and Busia. These areas typically lose more than 100 kg/ha/year of NPK. The Lake Victoria crescent region, the central and northwestern parts of the country have severe depletion amounting to 80 – 100 kg/ha/year of NPK. Moderate to low depletion occur in the eastern and northern parts of the country, which are drier areas used mainly for livestock production.



Source: IFDC, (1999)

Figure 3: Nutrient Depletion in Uganda

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Source: FAO, (1989) as quoted in IFDC, (1999).

Other forms of land degradation

- (i) *Soil Compaction*: The districts most affected by soil compaction are found in the cattle corridor, i.e. Moroto, Kotido, Mbarara, Luwero and Masaka. The high animal population in these areas lead to soil compaction which in turn lead to serious soil erosion. The consequences of compaction are the decrease in voids (pore space) and an increase in bulk density, which leads to reduced infiltration of water and increased runoff (Zake, et al., 1997). Compaction also occurs in areas where heavy machinery is used for farm operations. Such areas include parts of Mukono, Jinja, Kigumba in Masindi, where large-scale farms are located. Even in areas where ox-plough is used intensively, soil compaction has been observed due to the shallow tillage depth of ox-ploughs. This problem is found in the districts of: Kumi, Soroti, Katakwi, and Lira.
- (ii) *Surface crusting*: Magunda (1981) observes that surface crusting is a result of poor soil structure, particularly on soils that are under continuous cultivation. Low organic matter, heavy rainfall, soil management with heavy machinery and heavy silt loads in running water are important factors that contribute to soil crusting. Crusting leads to failure of seeds to germinate.
- (iii) *Water logging*: Excessive saturation of soil by water is common and severe in most river valleys, swamps and areas adjoining Lake Victoria and Lake Kyoga, where most hydromorphic soils occur.
- (iv) *Leaching*: Leaching is a problem in light soils that are not planted with deep rooted crops (Zake – personal communication).

4. Causes of Land Degradation in Uganda

Land degradation in Uganda is directly attributed to natural factors including soil type (erodibility and vulnerability), relief and climate as well as deforestation and unsustainable farming practices such as the cultivation of fragile lands (steep slopes and swamps), continuous cultivation of land without fallowing or use of organic and inorganic fertilizers, limited investment in soil conservation, deterioration of erosion control structures such as terraces, overgrazing, etc. (ibid.). However, underlying these proximate causes (particularly those related to human activities) are more fundamental causes—such as population pressure, poverty, predominance of low-input subsistence farming (limited commercialization) and land tenure insecurity—whose effect on land management in different circumstances are not very well understood. Furthermore, government policies relating to input supply, infrastructure and market development, land tenure, etc. affect these underlying causes of land degradation (Figures 4 and 5) in many ways that are difficult to predict; hence the need for more research.

Figure 4. Causes of Soil Nutrient Depletion and Policy Influences

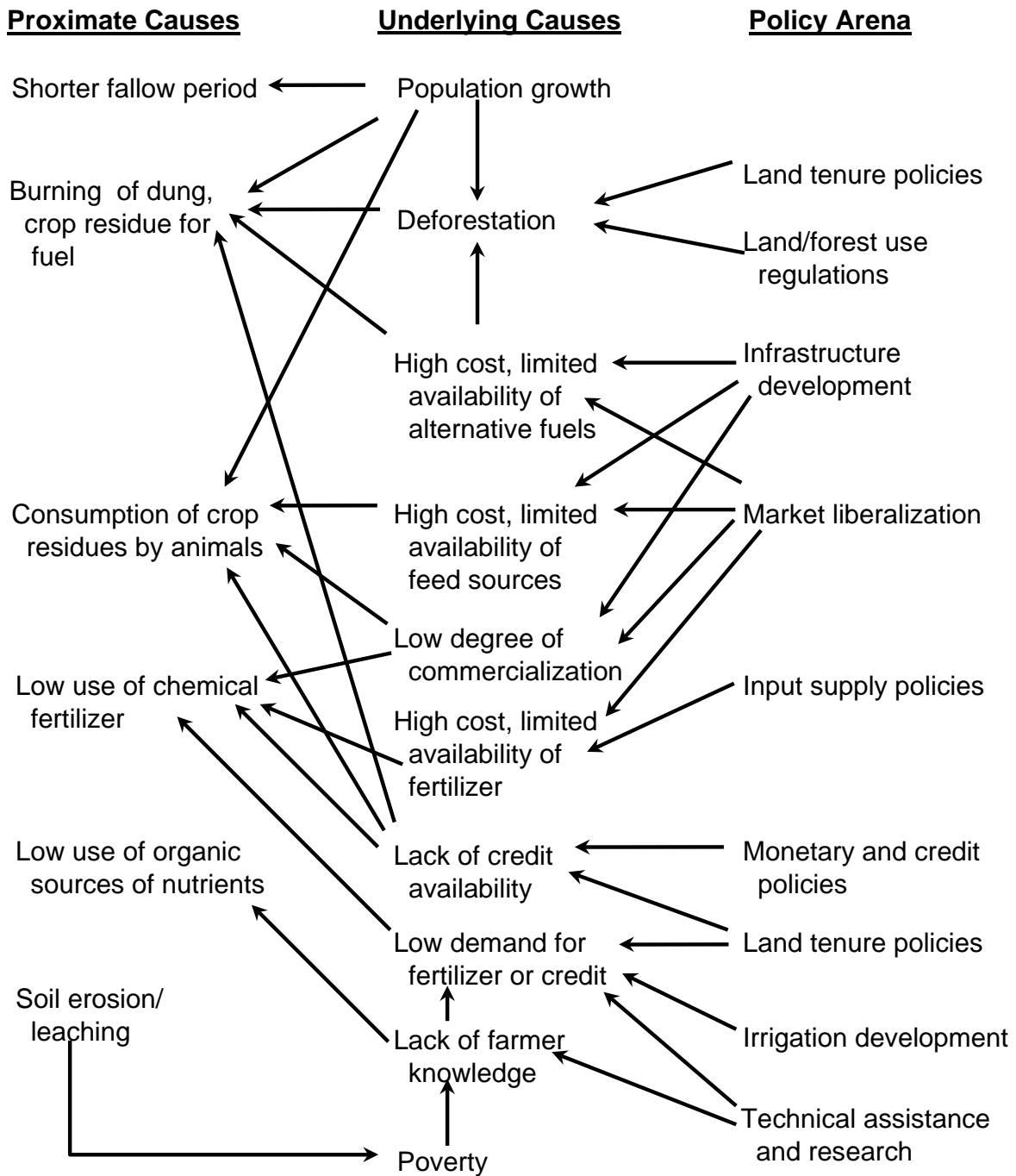
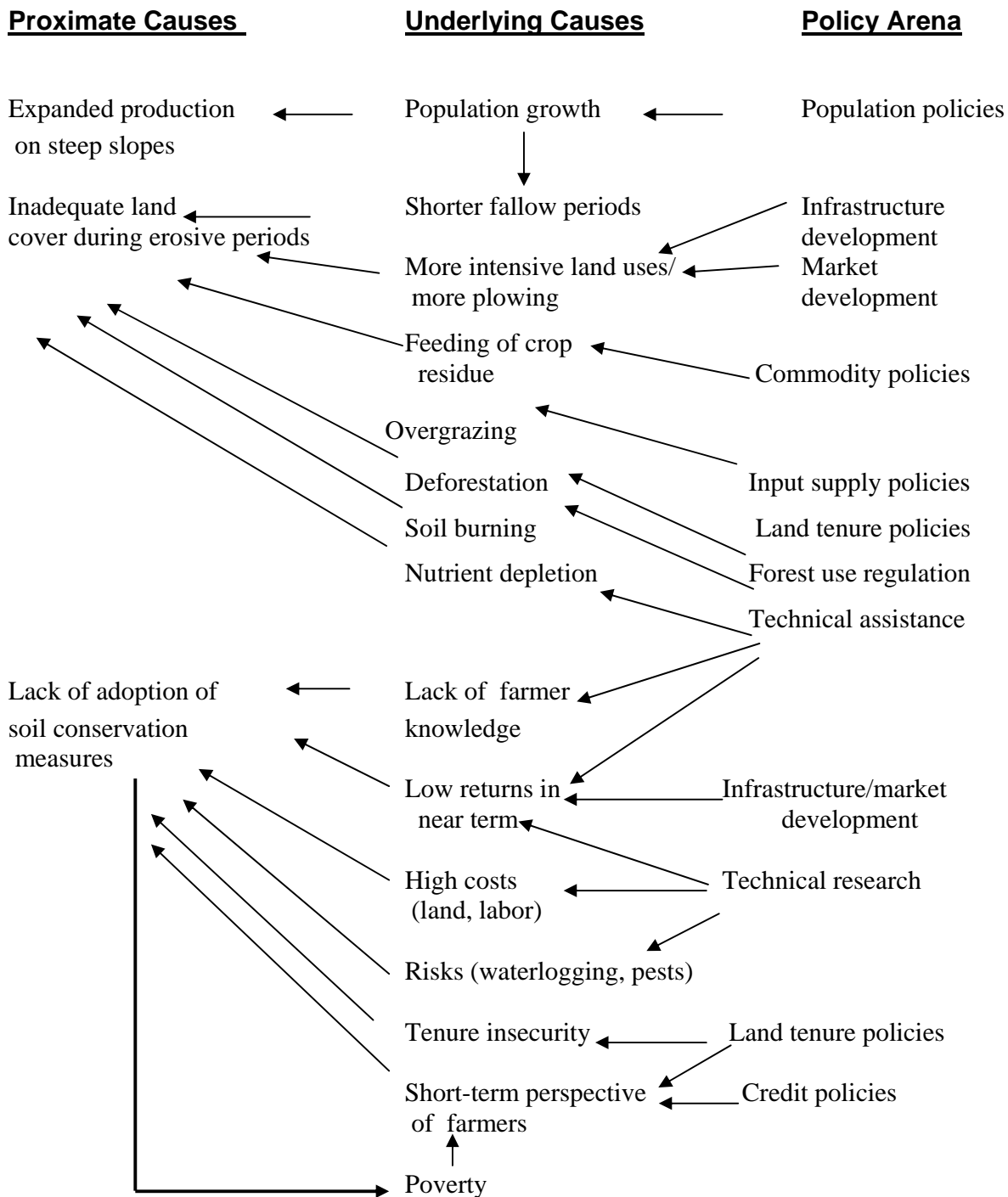


Figure 5. Causes of Soil Erosion and Policy Influences



This section presents hypotheses about the causes of land management problems (in particular soil fertility depletion) in Uganda, starting with the more proximate causes followed by the underlying causes (socio-economic, policy and institutional factors). The hypotheses have been derived from available literature and information gathered during the fieldwork of the characterization exercise. The field study for characterizing land management problems in Uganda was conducted in nine districts, namely, Mbarara, Kabale, Bushenyi, Mbale, Tororo, Kumi, Mukono, Luwero and Masaka. The selection criteria (constrained by the boundaries of the project) were mainly farming systems representativeness and severity of land degradation problems as revealed by the available literature. Mbarara and Bushenyi represent the western banana-coffee-cattle system and some elements of pastoralism especially for eastern Mbarara; Masaka, Mukono and Luwero represent the intensive banana-coffee lakeshore system and the forest savanna mosaic banana coffee system; Tororo, Mbale and Kumi are located in the northern and eastern cereals-cotton-cattle system; and finally, Kabale represents the Kigezi annual crop montane system (Bashaasha, 2001; MPED, 1997).

Proximate Causes of Land Degradation

Traditionally, soils in Uganda were cultivated until crop yields deteriorated to unacceptable levels and the “tired” pieces of land were then rested (“fallowed”) to restore fertility. Research shows that these rests were sound ways of restoring soil productivity as they helped increase soil organic matter, recycle leached nutrients and improve soil physical properties (Jones, 1972). In addition, various soil conservation measures were widely practiced prior to the 1970s, promoted by educational programs and often enforced by local administrators. However, a combination of several factors including political turmoil and the breakdown in former administrative structures led to the neglect or destruction of older investments (such as terraces) while at the same time discouraging new investments in soil conservation (Zake, 1992). Reports from the field study indicate that fallow periods have greatly declined or nearly disappeared in densely populated areas such as Kabale, although there are abandoned plots of land that should not be mistaken for fallow. Rapid appraisal exercises in Kabale by Lindblade et al. (1996) had similar findings (perception by the local people that fallow land has disappeared), although their analysis of photographs found that more cropland was fallowed in 1996 than 1945 despite the doubling of population in Kabale. Nonetheless, the average length of fallow periods of 14.2 months (found by Lindblade et al.) doesn't seem long enough to rejuvenate soil fertility. In Mbarara, farmers admitted that ideally, land should be fallowed for five to six years, but have been forced to reduce fallow periods to less than two years (or even zero) due to land scarcity (Bashaasha, 2001).

The decline in use of fallow coupled with limited or non-use of inorganic and organic fertilizers to replace soil nutrients lost through harvesting and other avenues of nutrient loss has undoubtedly contributed to soil nutrient depletion in Uganda. Between 1980 and 1990, the use of nitrogen and phosphorous fertilizers, for example, dropped by 64% and 45% respectively; and less than 1% of Ugandan farmers were reported to be using commercial fertilizers by 1995 (MPED, 1995). The decline in fertilizer use coupled with population-led increase in food demand⁷ (which led to increased food harvesting) contributed to the high rate of soil nutrient loss (Figure 3). While the level of fertilizer use is believed to have increased since then (partly

⁷ Uganda's population grew by 43% over the same period.

because of fertilizer-use promotion efforts by NGOs such as Sasakawa-Global 2000), reports from the field study suggest only marginal increase in commercial fertilizer use. This is supported by the low figure of fertilizer imports into Uganda of only 6,000 tons between 1990 and 1996, which is far below the 1971 level (Figure 2).. Moreover, most of the imported fertilizer is used by large estates, which account for about 95% of total fertilizer consumption in Uganda (IFDC, 1999). This suggests very limited fertilizer use among the 3 million small-scale farm households (5% of national fertilizer consumption), yet they contribute a lion's share to Uganda's agricultural GDP.

Other practices that are believed to have contributed to land degradation in Uganda include increased cultivation on steep slopes, deforestation, bush burning, soil burning and increased encroachment of wetlands for crop production and brick making. Cultivating steep slopes and hilltops has contributed to soil erosion, particularly in the southwestern mountain region (Kabale, Kisoro and parts of Rukungiri districts), and this is evident in the silted water bodies. This problem is spreading to other farming systems. During the field visit to Mbarara, for example, coffee was reported to be regaining importance as a cash crop with the introduction of clonal coffee. However, because bananas (*matooke*) remain the leading commercial crop for this area, and because of increasing land scarcity, a few farmers are inter-cropping coffee with bananas while others are planting it on steep slopes towards hill tops, where it has limited chance of performing well because of soil moisture stress. Increasing deforestation arising from increased demand for charcoal and fuel-wood (both for cooking and brick making) was reported to have contributed to reduced vegetative cover (and soil loss) in all districts visited, except Kabale where there are no more forests to clear. It is estimated that between 1973 and 1986, Uganda lost a net acreage of 256 km² of natural vegetation to agriculture, thus exposing the land to agents of soil degradation (Zake et al., 1997).

The practice of bush burning as a means of rejuvenating natural pastures is common in the cattle corridor (parts of Mbarara and Luwero districts); and soil burning with the intention of releasing soil nutrients is widely practiced in Mbarara and Bushenyi as a seed bed preparation exercise, particularly for the millet crop. Both these practices have reduced land cover and soil organic matter, contributing to soil erosion. Within the cattle corridor, overstocking has resulted in rangeland degradation (loss of vegetation cover), manifested in patches of bare ground, animal trails and severe encroachment of the pastureland by bushes and stubborn weeds such as *Lantana camara* (Kisamba-Mugerwa, 1992; Bashaasha, 2001). In all districts visited during the field study, there is increasing encroachment on wetlands for brick making and production of rice (particularly in Kumi district), yams and horticultural crops such as vegetables in areas close to towns. This practice contributes to the drying up of swamps and is hypothesized to be contributing to the erratic weather conditions in various parts of the country⁸—a possible deterrent to fertilizer use since unreliable rainfall increases the uncertainty of returns to fertilizer, with yields sometimes being reduced by the application of fertilizers if there is insufficient moisture.

⁸ One of the agricultural officers interviewed during the field study speculated that erratic weather (unreliable rainfall) is the main reason why farmers are pushing crop production to wetlands to reduce the risk of low moisture. However, if it is true as speculated that wetland encroachment contributes to the occurrence of erratic weather, this then suggests a downward spiral of more severe wetland cultivation and erratic weather.

Besides the above-mentioned human related activities, the flow of nutrients is also affected by natural factors such as soil type, relief and climate. Highly erodible soils, steeply sloping lands and heavy rainstorms can cause serious land degradation if the mitigating factors are not strong enough to counteract these natural factors. Rainfall is considered the single most important climatic factor responsible for soil erosion in Uganda, mainly because of the high intensity of rainstorms that characterize Ugandan rainfall. Intensities above 300 mm per hour have been recorded in Uganda (Magunda and Tenywa, 1999; Zake et al., 1997). Wind erosion is also significant, and is particularly intense during the dry season after bush burning. In the high rainfall areas of Kabale, Mbale and the Lake Victoria crescent, leaching is significant, especially in sandy and loamy soils (NEMA, 1998). Compared to these natural factors, however, the contribution of humans to land degradation is likely greater, through the unsustainable practices discussed above. This suggests that it is possible to mitigate land degradation through changes in human behavior regarding the use of land and other natural resources. However, changing human behavior requires having a clear understanding of farmers' perspectives and constraints towards land management as defined by the socioeconomic, policy and institutional environment within which they operate, because this influences farmers' land management decisions. Discussed below are some of the socioeconomic, policy and institutional factors underlying land degradation or improvement in Uganda.

Underlying Causes of Land Degradation

Population Pressure

Population growth is considered to be one of the most important factors behind the declining use of fallow in Uganda. As indicated earlier, fallowing was the traditional way of restoring soil productivity in Uganda, and it was effective in the past. However, population growth increased the pressure on arable land to increase food production and in so doing increased nutrient loss through harvesting. It has also contributed to the reduction in farm size because of increased fragmentation of land holdings, forcing farmers to reduce fallow periods and extend cultivation to steep and fragile soils, thereby fueling land degradation. Between 1969 and 1991, for example, Uganda's population increased by 121%, with the urban population growing at a faster rate (198%) than the rural population (66%) (MPED, 1995). The increase in urban population increased nutrient exports as many farmers began producing for the market, while rural population growth increased pressure on agricultural land, leading to smaller farm sizes (averaging 2 ha per farm household), shorter fallow periods and continuous land cultivation. This, together with increased nutrient exports to urban areas resulted in nutrient depletion. On the other hand, migration from rural to urban areas reduces population pressure on the land, compared to what it otherwise would have been.

Together with the limited availability and high cost of alternative forms of fuel⁹, population growth is believed to have promoted deforestation because of the resultant increase in demand

⁹ The January 2000 cost of Kerosene is Ushs. 905/ liter (1500 Ushs = 1US\$), while electricity costs Ushs 20/KVA for the first 30 units, Ushs. 70/KVA for the next 170 units, and there after 100 Ushs/KVA. It is estimated that electricity provides only 2% of the country's energy requirements while the majority of Ugandans rely on biomass energy, with fuel wood providing over 90% of the country's energy requirements (APSEC, 2000).

for fuel. Likewise, population-led increase in demand for livestock products is believed to have promoted overgrazing, because of increased livestock numbers. Population pressure can also contribute to other socio-economic problems, which themselves contribute to land degradation. For example, poverty (which may undermine farmers' ability to invest in soil conservation) may be worsened by population growth as a result of resource constraints and decreasing returns to capital and labor in agriculture (Pender, 1998). Land tenure may become more insecure and local institutions and organizations can break down as a result of population pressure, particularly if population change is rapid and large migration is involved, thus undermining the stability and homogeneity of communities (Pender and Scherr, 1998; Baland and Platteau, 1996). When this happens, collective efforts to manage common land (such as forests and grazing land) may become ineffective, leading to the degradation of such resources (Baland and Platteau, 1996).

Nevertheless, population growth doesn't inevitably imply land degradation. Evidence from other parts of the world suggests that population pressure may increase the value of land relative to labor and induce farmers to make labor intensive investments in land improvement and soil management, such as constructing terraces, composting or mulching (Pender, 1998; Tiffen et al., 1994). In Mbarara district, for example, densely populated areas closer to Mbarara town have managed to sustainably increase banana yields by as much as 65% through mulching, harnessing water, use of correct spacing and application of manure (SWC specialist, personal communication, 1999). Population growth may induce development of more privately-held property rights, which may favor investments in land improvement and better soil management, though this is much debated in the African context (Platteau, 1996). It may also induce development of infrastructure and markets, by allowing the fixed costs of these developments to spread over a larger number of beneficiaries mulching (Pender, 1999; Tiffen et al., 1994). Development of infrastructure and markets may in turn promote land-improving investments by increasing the value of land; though they may instead promote more rapid exploitation and degradation (Pender, 1999). The ambiguity about the effect of population growth on land management justifies the need for further research on this subject, to get a better understanding of the impact of population growth on land management in Uganda.

Local Market Development

As shown earlier, fertilizer use (both organic and inorganic) in Uganda is low, but it is not clear whether low fertilizer demand is due to limited benefits (low profitability) of applying fertilizers on highly fertile soils, the mere belief that Uganda's soils are very fertile (as stated by Chenery (1960)) such that there is little perceived need to apply fertilizers, or whether it is a result of market failure (Yanggen et al., 1998). Little is known about the profitability of fertilizer use in the different farming systems of Uganda. The estimated marginal rate of return to investment in improved maize seed (Longe 1) and fertilizer (DAP and UREA) is 122% (Uganda's Investment in Developing Export Agriculture (IDEA) Project, 1998), suggesting that it is profitable to use fertilizer on maize, but it is not clear if such high returns could be obtained for other crops. Besides profitability issues, there are structural impediments in the economy encumbering the functioning of markets in Uganda that may be undermining fertilizer use. Lack of credit, for example, makes poor farmers unable to use purchased yield-enhancing inputs even if they are

aware that the returns from doing so are high; and high transportation costs in a subsistence basic cereals producing community far from the nearest road might lower farmers' response to increased cereal prices.

Local factor markets (e.g., for credit, land, and labor) in rural Uganda are poorly developed or completely missing in some parts of the country. Much as recent financial sector reforms were necessary from a macro-economic point of view, they not only increased real interest rates but also eliminated large parts of the existing financial infrastructure, thus reducing farmers' access to credit (Mosley, 1999). Between 1992 and 1993, for example, there was a significant increase in credit rationing of agricultural producers; and the density of financial infrastructure in rural areas was low, with only 42% of rural communities (as compared to 88% of urban communities) having access to formal credit within at least 10 km. (Deininger and Okidi, 1999). Worse still, it is evident that the few available credit institutions discriminate against agriculture, with loans (in 1992/93) heavily concentrated in trade (44% of loans) and services (19%), while livestock and crop farming ranked much lower at 15 and 11.5 percent respectively. The high interest rate of 24 percent per annum charged on commercial loans is also believed to have deterred farmers' willingness to seek credit from formal sources.

The absence of a well functioning rural financial system is a significant obstacle to agricultural development in Uganda. This is because lack of credit not only contributes to a short-term perspective of farmers—which fuels over-exploitation and degradation of the natural resource base (Pender, 1996; Holden et. al., 1996), it also reduces their ability to acquire and use purchased inputs needed for sustainable agricultural development (Larson and Frisvold, 1996).

Recent studies (Tumuhairwe et. al., 1998; Kasenge, 1998) list low farm income or lack of cash as one of the reasons for non-adoption of land management technologies in Uganda, particularly those involving construction of soil conservation structures such as trenches and soil bunds. This suggests that increased access to affordable credit could encourage investment in land improvement. The reported increase in fertilizer use by small-scale farmers during the field study is to a large extent attributed to in-kind credit from NGOs to farmers. On the other hand, credit for fertilizer and other inputs may allow farmers to substitute short-term inputs for longer-term investments in land conservation and improvement (Holden, 2001). The actual net effect of credit on land management is thus an empirical issue that needs to be studied.

When formal credit markets are not well developed (as is the case in Uganda), farmers must rely on their own savings as a source of investment capital. However, the rate of savings in Uganda stood at only one percent of GDP in 1994 (World Bank, 1996), implying that without increased mobilization of rural savings, there are not many options for promoting land improvement investments among credit constrained farmers except increasing their access to affordable sources of credit. As Reardon et. al. (1996) argue, income from off-farm sources can serve to generate funds for agricultural investments where credit availability is low. This argument is supported by evidence from Mbarara district, where people who used to completely rely on commerce for a living are now embracing agriculture (crop and livestock farming) as an alternative source of income, using funds from off-farm businesses to finance agricultural investments, including the purchase of commercial fertilizers. Thus, creating opportunities for off-farm employment in rural areas may be one way to encourage investments in land

improvement. On the other hand, off-farm employment opportunities may compete for labor with agricultural activities, and thus tend to reduce labor-intensive land management practices.

Lack of a well-developed labor market makes labor scarce and costly in some places in rural Uganda, which undermines farmers' ability to invest in soil fertility conservation and other practices that are labor intensive. Labor is reported to be scarce and expensive in many parts of Uganda, partly because of low labor mobility arising from ethnic heterogeneity and limited awareness of wage differences across regions. For example, the 1998 average daily wage rate for casual labor in eastern Uganda districts of Soroti, Mbale and Kumi was Ushs. 1000 compared to Ushs. 2500 in central Uganda districts of Mpigi and Luwero (MFPED, 1999). Between 1989 and 1997, the wage rates for casual, permanent and contract labor increased at an average rate of 21%, 24% and 29% per year respectively (MFPED, 1997), pushing hired labor beyond the reach of the majority of small scale farmers. As Deininger and Okidi (1999) observe, imperfections in land, labor and capital markets mean that household endowments have a direct effect on the level of agricultural production and use of other inputs. Most farm households in Uganda rely entirely on family labor to carry out all farm activities including soil conservation. Thus, limited availability of family labor could easily be one of the significant factors undermining farmers' ability to invest in soil conservation. Labor is listed as a major constraint to the use of terraces as a soil conservation measure in Kabale (Miuro, 1997); and the use of organic sources of soil nutrients in the hilly banana growing areas of Uganda is also very highly constrained by limited availability of labor to transport and apply these inputs on the crop fields (Rubaihayo, 1991).

Besides malfunctioning factor markets, the low level of commercialization of smallholder agriculture is another limiting factor to the use of purchased inputs such as fertilizer to replenish soil fertility. In 1996, about 25% of crop producers reported to be pure subsistence producers and about 70% were only marginal market participants who sell less than 20% of their output, with more than one third of reported sales being in bananas (matooke), root crops and bulky products (Deininger and Okidi, 1999). As Ehui (1995) observes, a low degree of commercialization limits the ability of small farmers in Africa to use purchased fertilizer and feed, making crop residues the primary source of feed and manure the primary source of fertilizer. Paradoxically, however, the use of manure as fertilizer in Uganda is generally low (MPED, 1996), although it varies across farming systems. A recent study shows that the likelihood of using animal manure as fertilizer is significantly higher in the intensive banana-coffee lakeshore system compared to the pastoral farming system, but there is no difference in manure use between the western banana-coffee-cattle and pastoral farming systems (Sserunkuuma, 1999). The same study indicates that the probability of using animal manure as fertilizer at the household level increases with availability of labor to transport and apply the manure (this is corroborated by the work of Rubaihayo (1991) in the hilly banana growing areas of Uganda), access to extension services and distance to markets—although one would expect its use as fertilizer to be higher among closer-to-market farmers (especially when inorganic fertilizers are scarce and expensive) because of the better terms of trade they face. However, where inorganic fertilizers are available and affordable, closer-to-market farmers may prefer to use these instead of manure, because the better farm-gate prices they face may make purchased fertilizer use profitable enough to justify using it. This is one explanation for the negative relationship between manure use and access to markets.

Another possible explanation for this finding is related to the low value to volume ratio of manure, which makes it less transportable and thus less tradable. Because livestock production

requires sizeable land for grazing (except in zero grazing systems), which land is not readily available close to towns (reason why the predominant method of feeding cattle in peri-urban areas is zero grazing), large herds of cattle are mostly found in more remote rural areas where land is more abundant. This translates into large quantities of animal manure accumulating in rural areas where it can be accessed and used for free or through market-type arrangements. Close to urban areas, animal manure use is constrained by the fact that small quantities are produced in these areas, and being bulky makes it very expensive to transport from surplus rural areas for use in deficit peri-urban (closer-to-market) areas (ibid.). Although there are reports of increased trading of manure, particularly in central Uganda (Bashaasha, 2001), its low value to volume ratio has greatly undermined the development of a market for manure in Uganda. Besides being less tradable, manure use may be hindered by farmers' lack of knowledge about modalities of its application and/or its usefulness, an issue that could be remedied through better delivery of extension services. For example, one of the farmers interviewed during the field visit to Luwero district believed that cow dung should be applied only to the banana crop, and since he wasn't growing any bananas, he gives it away for free (ibid.).

Market Liberalization

Through their effect on output and input prices, market liberalization policies in Uganda have influenced land management at the farm level. The liberalization of commodity markets has in many cases improved prices received by farmers, which is an incentive for improved land management. However, following the liberalization of exchange rates and input trade as well as government withdrawal from direct procurement, distribution and subsidization of agricultural inputs, the cost of imported fertilizers and other agro-inputs went up. Despite increased competition due to entry of several international and local companies in the agro-input business over the past 4 to 5 years (MFPED, 1997), fertilizer prices have remained beyond the reach of most farmers. For example, the average prices of NPK, CAN and SSP in 1999 were Ushs. 683/kg, Ushs. 717/kg, and Ushs. 683/kg respectively in central Uganda; and the prices were significantly higher in western Uganda, averaging Ushs. 780/kg for NPK and Ushs. 867/kg for both CAN and SSP (MFPED, 1999). A combination of high fertilizer prices, relatively low and unstable agricultural output prices and the low degree of commercialization of agriculture in Uganda limits farmers' demand for purchased fertilizers and may thus be a significant contributing factor to soil fertility depletion. Apart from discouraging fertilizer use, increased fertilizer prices may affect the use of other inputs and soil conservation investments depending on whether they are complements or substitutes to fertilizers. For example, if the use of soil conservation methods is complementary to fertilizer use (such as the construction of bunds and terraces to prevent loss of the applied fertilizer nutrients through runoff), increased fertilizer prices may undermine investment in such methods (Pender, 1998; Pender and Kerr, 1998). If such complementarities exist in Uganda, they could be exploited to stealthily promote soil conservation investments through increased fertilizer use. Whether or not this is true is an empirical question that calls for research. During the field study, farmers also complained that the liberalization of input trade has resulted in malpractice by private input dealers who sometimes sell expired or adulterated inputs.

Although markets have been liberalized, continued intermittent interventions in the market for inputs may be undermining private sector investment in these markets. For example, fertilizer

donations from foreign governments have occasionally been distributed at below market prices, undermining private sector traders. Other interventions have been in the form of distribution of free or subsidized seeds in areas hit by drought or instability. Such interventions can frustrate the development of the nascent input marketing sector.

Decentralization and Technical Assistance Programs

Through its decentralization policy, the government of Uganda has made extension the responsibility of districts, which is expected to make the extension services delivery system more demand driven and, thus, more responsive to local priorities. The functions and services regarding land use, management and administration have also been made the responsibility of the local government (APSEC,2000). However, two issues about funding were raised by district civil servants in the departments of agriculture and environment as directly undermining their efforts to address land management problems. First, complaints were raised that activities of the agricultural department (including extension) are receiving low priority in terms of budget allocation compared to other departments such as road rehabilitation and maintenance, education, health, etc. This complaint is supported by the fact only that three out of 32 districts whose 1997/98 budgets had been analyzed by the ministry of Agriculture (MAAIF) had allocated more than 3% of their budget to agriculture (Government of Uganda, 1998).

The field study revealed that much less than what is allocated in the district budgets is actually spent on agriculture. Limited support to the agricultural department translates into poor facilitation and demoralization of extension staff, hindering the delivery of extension services to farmers, yet extension has a role to play in promoting improved land management by increasing awareness of soil management practices and their benefits. The Luwero-based farmer who thought that cow dung should only be applied on bananas (Bashaasha, 2001) is an example of lack of awareness among some Ugandan farmers on land management issues. The second complaint was about tax revenues from natural resources such as forests, lakes and wetlands. The district officials argued that decentralization is incomplete without transfer of tax revenues accruing from these resources that are still administered by the center (APSEC, 2000). This was said to undermine the districts' revenue base and capacity to carry out their delegated functions covering land management.

Another issue associated with decentralization that affects land management is the fact that the local councils that make the laws (including those related to the management of land and other natural resources) also double as the enforcers and implementers, which creates a tendency for the elected councilors to shy away from implementing technical policy decisions made for fear of political repercussions from the electorate, especially if the decisions threaten their personal political interests (ibid.). Through decentralization, an opportunity was created for district administrations to link more closely with the National Environment Management Authority (NEMA), enabling them to produce bylaws targeted at proper land management and prevention of land degradation. However, because the Local Government Act of 1997 does not specifically provide for the appointment of a District Environment Officer (DEO), yet s/he has to be supported by the district, some districts have lagged behind in appointing DEOs, which might delay the onset of programs to address the problem of land degradation (ibid.).

Another factor that could be hampering the use of inorganic fertilizers is the conflicting messages from different programs and organizations involved in technical assistance in agriculture. Farmers in Kabale reported that while some NGOs such as Sasakawa-Global 2000 are promoting inorganic fertilizers, those promoting organic farming exemplified by CARE are telling farmers not to use inorganic fertilizers. There is a need, therefore, to harmonize the messages being sent to farmers. Land fragmentation in Kabale was reported to be a deterrent to fertilizer use not only because of the long distances over which farmers have to carry the fertilizers (from homes to different land plots), but also because of the externalities involved. Farmers with plots of land located on steep slopes are reluctant to apply fertilizers for fear that it will be washed down to benefit farmers with plots lower on the plots or in valley bottoms.

Infrastructure

Although Uganda has a relatively high density of roads—about 1.6 km per 1000 persons (U.S. Library Congress, 1992)—compared to many other African and Asian countries (Ahmed and Donovan, 1992), the condition of many roads (particularly rural roads) has been poor for a long time. Despite the recent increase in rural road improvement and maintenance investments by districts following the government policy of decentralization and the government plan to spend \$1.5 billion on road improvement over the next 10 years (Government of Uganda, 1998), the condition of rural roads will most likely remain poor in the near future. This is partly because this level of government investment in rural roads is much less than what was called for in the original version of the modernization plan (*ibid.*). In addition, most of the funds are allocated for trunk roads; only about \$10 million was allocated to the rehabilitation of feeder roads in 1998/99.

The general effect of poor infrastructure on performance of the agricultural sector is well known. Poor infrastructure—particularly roads—hampers the transmission of price signals to farmers and renders the production of most agricultural products in poorer developing countries less sensitive to price incentives (Chibber, 1988). Poor infrastructure also impedes farmers' access to modern agricultural inputs, which are usually imported (or produced in urban areas) and most likely transported through urban areas on their way to the rural areas. To the extent that input demand and output supply are price elastic, improvement in road condition may induce farmers to increase both the cultivated area (production) and the use of yield-enhancing inputs, which in turn increases agricultural output. Furthermore, the average distance to markets for consumer goods and inputs (16 km and 28 km respectively); to private (truck) or public (bus) transport (of 8 km and 13 km respectively); and to tarred roads (of 33km) at the national level is quite high (Deininger and Okidi, 1999). A combination of long distance to markets, poor road condition, limited availability of transport services and the high cost of fuel raises the cost of connecting to factor and output markets, which in turn leads to high input and low output prices at the farm-gate. In 1993/94, farm-gate prices averaged only 17 percent of retail prices for maize and 33 percent of retail prices for beans (MPED, 1996).

The predicted effect of output prices on incentives for land conservation and improvement is nonetheless ambiguous. On one hand, higher prices may increase incentives to invest in land improvement (as a means of increasing output to take advantage of the higher prices), but on the other, they may increase incentives to rapidly mine the soil through intensified land use in the

absence of soil conservation (LaFrance, 1992; Pagiola, 1996). By increasing output prices at the farm-gate, therefore, better access to roads and markets could encourage more intensive land use and more plowing, which in turn leads to inadequate soil cover during erosive periods and, thus, soil erosion. Reports from the field study indicate that in many areas, increased access to markets (arising from improved road condition) has resulted in more land area being brought under cultivation (including marginal areas and wetlands) without corresponding increase in the use of appropriate conservation practices, leading to various forms of land degradation. These ambiguities suggest a need for empirical research to identify how changing price incentives have affected land management in Uganda.

Despite the reported improvement in access to markets arising from increased investment in road improvement, farmers in all places visited during the field study complained of fluctuating output prices at the farm-gate, particularly for perishables. Close though they are to big markets in Kampala and Jinja, farmers in Mukono district reported that the price of passion fruits drops from a high of Ushs. 12,000-15,000 per tin (12-14 kg) at the beginning of the harvest season when supply is still low to as low as Ushs. 2,000 per tin at the peak of the harvesting season (Bashaasha, 2001). The farm-gate price of *matooke* in Mbarara can go lower than Ushs. 500 per bunch at the peak of the harvesting season and higher than Ushs. 3,000 off-season. The fear that prices could fall even lower following fertilizer-driven increase in yields cannot be overlooked as a contributing factor to limited use of fertilizers and other purchased inputs for land improvement. Farmers have a vivid memory of a 40 percent drop in maize prices at the end of 1992 as a result of a bumper harvest that followed government efforts to promote increased maize production (Nygaard, et. al, 1997).

Land Tenure

The standard hypothesis about land tenure and land management is that non-exclusive and insecure land rights will lead to under-investment in land improvement (and promote land degradation), because recouping benefits from doing so is not guaranteed. Tenure security determines the extent to which farmers may benefit from land improvement investments. In the extreme case in which farmers expect to hold land for only the current season, they will have no incentive to invest; rather their incentive is to get the maximum that they can from the land, even if that means undermining its future productive capacity. Furthermore, tenure security and land transferability (another aspect of land tenure) determine the value of land as collateral, thereby influencing access to credit and demand for purchased land-improving inputs; and land transferability allows land to be used by more productive users, who are more likely to invest in land improvement (Pender and Kerr, 1999).

Deininger and Okidi (1999) argue that land rights in Uganda are to a large extent insecure and overlapping, that they impede land improvement investments and pose an obstacle to the functioning of land rental markets. In central Uganda where access to infrastructure and markets is most favorable, 82% of the cultivated land area is held under mailo tenancy (whereby the occupants pay rent to the mailo land owners) and other arrangements that deny them some rights to the land (such as cutting—and sometimes planting—trees), while 17% is under leasehold, and 1% under freehold (ibid.). The field study revealed that most farmers hold land under squatter or customary type of tenure. Tenant farmers usually have “a gentleman’s agreement” with the

landowner to settle and cultivate a designated piece of land (Bashaasha, 2001). This type of tenure looks precarious, suggesting that land tenure insecurity may be a significant factor hindering investments in land improvement in Uganda. However, farmers interviewed during the field study didn't seem to be worried about losing access to land held under such tenurial arrangements. Many felt that the existing land law, which requires the actual owners to compensate them for all developments before evicting them, was protective enough of their interests (Bashaasha, 2001); and that the tenure system wouldn't deter them from making land improvement investments if they had the ability to do so. This conforms to the belief of some authors exemplified by Kafureka (1992) that "the peasant doesn't need insecurity (or security) as a push force to invest in land improvement. He will always be willing to invest so long as he has the means since his livelihood and major source of income is from land". Therefore, the widely held belief that tenure insecurity has significantly deterred agricultural development in Uganda is questionable.

Available evidence on the impact of land tenure on land improvement investments in Uganda is mixed. Some studies (Kisamba-Mugerwa, 1995; Roth et al., 1994) show that land tenure insecurity has undermined farmers' incentives to invest in land improvement; while Sserunkuuma (1998) shows that land titling doesn't guarantee investment in land improvement or sustainable land use. In a study conducted in the pastoral farming system (Nyabushozi county, Mbarara district), 24 percent of the surveyed households with exclusive, secure and transferable rights to grazing land were found to be overgrazing (ibid.). This is corroborated by the work of Kisamba-Mugerwa (1992), which observed biophysical indicators of overgrazing (patches of bare ground, animal trails and severe bush encroachment) on state-owned, private and communally grazed areas. Other studies such as MISR/LTC (1989) present evidence showing that farmers with insecure tenure have made more land improvement investments than their counterparts with secure tenure. The explanation for this counterintuitive finding is based on the traditional concept of gaining rights to land through land use, sometimes known as land grabbing. When faced with tenure insecurity, farmers may invest in land improvement hoping to enhance their claim to the parcel in case of a dispute (Besley, 1995).

The underlying reason for the mixed evidence on the impact of tenure on land improvement investments may be related to lack of understanding of what really constitutes tenure security by the different scholars of the subject of land tenure. It is important to recognize that tenure security doesn't require private land title, or even private ownership. There is substantial evidence from elsewhere in Africa that farmers can be secure in access to a given piece of land and even make investments on it without having a title, and even when land is communally owned (Otsuka, 1998; Platteau, 1996; Place and Hazell, 1993). What is required is recognition and respect of the right of an individual or well-defined group to continue to use a given piece of land over a long enough term for investments to be viable. This may exist under communal or private tenure, and whether or not such rights are officially sanctioned by the state through titling or other means. This calls for further exploration of the subject of land tenure in Uganda, to get a better understanding of what actually constitutes tenure security, whether or not lack of it has contributed to land degradation and to what extent. Such information would be very useful in guiding the implementation of the current land reforms in Uganda as stipulated in the Land Act of 1998.

Another common assumption about land titling is that it may facilitate access to credit, which increases farmers' ability to acquire and use purchased inputs as well as to make land improvement investments. However, available evidence from elsewhere in Africa suggests that lack of land titles may not be a serious constraint where formal credit markets are not well developed and farmers rely primarily on their own savings or informal sources of credit (Place and Hazell, 1993). Besides, several studies carried out in Uganda (Kafureka, 1992; Mamdani, 1992; Muhereza, 1994; and Bazaara, 1994) show that many of the land titleholders who use their titles to acquire loans usually invest in non-agricultural ventures like transport and commerce, which appear more lucrative than agriculture. This is due to the high-risk nature of farming relative to other forms of business; the underdeveloped, inefficient and unreliable marketing system for agricultural outputs; and the high interest rate charged on commercial loans (24% per annum). Under such circumstances, as Bruce (1986) observes, loans themselves may be a source of insecurity since many lenders may use mortgages to deprive the poor small holders of their land.

Even if one was to borrow and invest in agriculture, Nsabagasani (1997) calls it an illusion to assume that mere land titling can facilitate loan accessibility because banks have other considerations such as the location of the land, whether or not the loan applicant has another source of income and how much is earned from the other source, whether it is cost effective to execute the loan, etc. Indeed, there are many land titleholders that have been denied credit by formal financial institutions. Having a friend or an acquaintance working in the loan department of the bank may be more useful than a title; and sometimes one's ability to pay a bribe may be the deciding factor as to whether or not s/he gets the loan (Bazaara, 1994). In summary, land titling doesn't guarantee access to agricultural credit nor the use of such credit, once obtained, in agricultural or land improvement investments. This suggests a need for more research to gain a better understanding of the linkages between land tenure, access to credit and agricultural investments in Uganda.

Weather patterns

The erratic weather (unreliable rainfall) reported in all nine districts visited during the field study might also be contributing to low fertilizer use because returns to fertilizers are highly dependent on soil moisture, with yields sometimes being reduced by fertilizer use under conditions of low soil moisture. In areas with less reliable rainfall, investing in the provision of affordable irrigation water to farmers may, therefore, lead to increased fertilizer use. Water conservation methods, such as terracing, mulching or digging trenches might also reduce the risk of low moisture. Shaxson (1999) argues that efforts to conserve water and increase soil porosity not only achieve more short-term benefits (and are thus more likely to be adopted) than soil conservation methods per se, but also achieve soil conservation "by stealth".

Pests and Diseases

High pest and disease pressure may also be a deterrent to improved land management. The practice of using coffee husks for mulching and recycling of soil nutrients (when the coffee husks decompose) has been discouraged countrywide, for fear that they spread coffee-wilt disease. Pests and diseases may also limit the response to fertilizer use. For example, pests such

as nematodes that attack the root system of crops limit the ability of plants to absorb nutrients, thereby decreasing the returns to fertilizer and discouraging fertilizer use. Use of manure may also increase the risk of pest attack, by creating a favorable breeding environment for pests. On the other hand, non-use of fertility replenishing inputs (manure and inorganic fertilizers) depletes the soil of its fertility, making the crops that are grown on such soils to be more susceptible to disease and pest attack. Thus, the two issues (soil fertility and pest/disease problem) need to be addressed together.

Poverty

Most of the constraints to improved land investment listed above are worsened by poverty. More than half of Ugandans (56%) lived below the poverty line in 1992, i.e., they earned less than 11,500 Ushs. (1214 Ushs. = 1US\$ in December 1992) per month. Although there was a 12 percentage point decline in poverty over a 5 year period (1992 to 1997), the poorest 20 percent of the population became poorer (APSEC, 2000). For the rural poor (who are the majority), poverty is mainly attributed to low crop yields resulting in part from land degradation. Poverty can be both a result and a cause of land degradation. Under intense stress to meet subsistence needs, poor farm households may react in ways that are deleterious to soil fertility because they cannot afford to make land improvement investments, such as application of adequate soil nutrients. The failure to make land improvement investments leads to further reduction in crop yields and returns from agriculture, contributing to greater poverty. This is a vicious circle between poverty and land degradation. Deforestation and overgrazing can be increased by poverty because of people's inability to afford alternative fuel and feed sources. Poverty also increases the short-term perspective of farmers and may limit their interest in investing in making long-term investments in soil and water conservation (Pender, 1996; Holden et. al., 1998). Lack of education or limited access to information associated with poverty may cause farmers to be less aware of land degradation problems, or to attribute such problems to causes beyond their control, and may thus reduce their efforts to address such problems (Ervin and Ervin, 1982).

If the definition of poverty is extended to include lack of assets or wealth, then poverty combines with culture to promote land fragmentation. Due to lack of alternative assets (poverty), parents are forced to sub-divide land among their offspring, which has greatly contributed to land fragmentation and small size of farms. The average farm size in Uganda is about 2 hectares and is definitely much less in places like Kabale. There is evidence (Kasenge, 1998) that shrinking farm size has contributed to land degradation in Uganda. This is partly because land endowment directly affects the adoption of soil conservation technologies. A farmer with limited land, for example, may not use terraces or bunds—even where they are the most effective soil conservation measures—because they reduce the effective land area under crops, thereby reducing output. Land shortage was listed as the most limiting constraint against the use of fallowing and crop rotation as soil conservation measures in the hilly banana growing areas of Uganda (Rubaihayo, 1991). Land fragmentation also reduces the effective time spent on actual agricultural work, as farmers spend much of their time walking from one plot of land to the next. It discourages fertilizer application and other investments in land improvement because of the externalities involved (e.g., fertilizer applied on plots uphill being washed down by rain to benefit farmers with plots lower on the slope), and also because of the difficulty of protecting investments such as trees and bunds on more distant plots from theft or damage.

This notwithstanding, there are also reasons to believe that poor people may have a higher incentive to conserve their land. Since they may own little else than the land they occupy, poor farmers may have more incentive than wealthy ones to manage what they have carefully. They may have few alternative investments available to them, causing them to give priority to investing in the land. Furthermore, the opportunity cost of poor farmers' labor time may be very low at certain times of the year, encouraging them to make labor intensive investments. Therefore, while poverty may promote land degradation (because of lack of access to investment capital, contributing short-term perspective of farmers, etc.), it may on the other hand promote better land management for the above-cited reasons. This makes the impact of poverty on land management an empirical issue that needs further study.

Privatization of Basic Services Delivery

Together with poverty, government withdrawal from financing the provision of basic services such as health and education (beyond primary level) has increased pressure on farm households to earn cash income to meet such expenses. While this has promoted farmers' participation in the market and diversification of agricultural production (through introduction of crops with high demand and value), it has nevertheless made it harder for farmers to use purchased inputs because paying school fees and medical bills is usually higher on their priority list than agricultural inputs. Thus, while the government privatization policy may on the one hand be promoting agricultural commercialization (which is expected to result in increased use of purchased inputs), it may on the other hand be undermining the use of purchased inputs because of expenditures for services (school fees, medical fees, etc.) that were provided by the government in the pre-structural adjustment era but are now the responsibility of individuals. This may be contributing to negative nutrient balances, as the nutrients exported from the farm (because of increased market participation) are not replaced through application of inorganic fertilizers.

5. Policy Impacts and Responses to Land Management Problems: Conceptual Framework

As we have seen, there are many factors affecting farmers' decisions about land management, and a complex set of linkages between government policies and these decisions. The impacts of government policies and programs on land management may vary greatly from one location to another, depending upon how such policies and programs are implemented in different locations, local agro-climatic conditions, the extent of local market development, farmers' endowments, and other local conditioning factors. It is essential to account for this complexity and diversity if policy makers are to understand the implications of the decisions they make on land management at the local level. At the same time, it is also necessary to focus on the key factors and their interactions, since it is not possible to develop policies for every situation. The conceptual framework guiding this research has been developed to address these challenges.

The conceptual framework is illustrated in Figure 6. Land management is determined by private decisions made at the farm household level, as well as by collective decisions made at the village

or higher levels. For example, farm households choose what crops to plant and how to manage soil fertility or conserve soil and water on their own land; but these decisions may be affected by regulations on land use set by local councils. Communities may also regulate use of communal grazing areas or other common lands, or may make collective investments in improving such resources, such as planting improved grasses or trees.

These household and collective decisions will determine current agricultural productivity and affect the condition of land resources (thus influencing future agricultural productivity), which in turn affect the level of farm income and rural poverty. It is important to emphasize that it is such outcomes (productivity, resource wealth, and rural incomes), and not adoption of specific land management practices *per se*, that are likely to be of most concern to rural people and to policy makers. It is thus critical to consider the ultimate impacts of any policy or technology on these outcomes, and the extent to which there may be trade-offs or complementarities among these objectives. For example, a strict regulatory approach (e.g., preventing farmers from planting annual crops on steep lands) may be effective in reducing soil erosion but may also have severe implications for agricultural production, food insecurity and poverty. On the other hand, there may be “win-win-win” strategies available that promote greater productivity and incomes as well as improved resource conditions. For example, promoting intensification of annual crops in less steep areas and perennial production on steep lands may reduce land degradation while increasing agricultural productivity and farm incomes.

Land management decisions are determined by many factors operating at different scales (plot, household, village, region, nation, and international). Many of these factors influence land management directly; for example, the type of soil, topography of the land and the climate will have a large impact on whether soil erosion is likely to be a problem and what options are feasible to address it. Demographic and socioeconomic factors—such as population density, access to markets, and the level of local prices—also influence land management. Some of these effects are direct; for example, access to markets and local prices determine the profitability of alternative practices. But some effects are indirect. For example, population pressure leads to smaller farm sizes and often to more fragmented holdings, which may reduce farmers’ ability or incentive to fallow or to invest in land improvements.

One important indirect way in which biophysical and socioeconomic factors affect land management is by determining what livelihood strategies are used in a particular location and by particular households. For example, in areas close to a major urban market having high agricultural potential, farmers are likely to be able to earn relatively high incomes from production of perishable cash crops (such as horticultural crops) or intensive dairy production. The land management problems, constraints and opportunities for improved land management in such a situation (e.g., declining soil fertility, potential for use of inorganic fertilizers or livestock manure, potential benefit of credit) are likely to be significantly different than in more remote areas where less intensive subsistence production may predominate (e.g., opportunities for improved fallows, need for land tenure security, appropriate technical assistance). The appropriate policy strategies for such situations are therefore also likely to differ.

The development of different livelihood strategies in a particular location, which we call “development pathways”, is influenced by many village level factors, such as agricultural

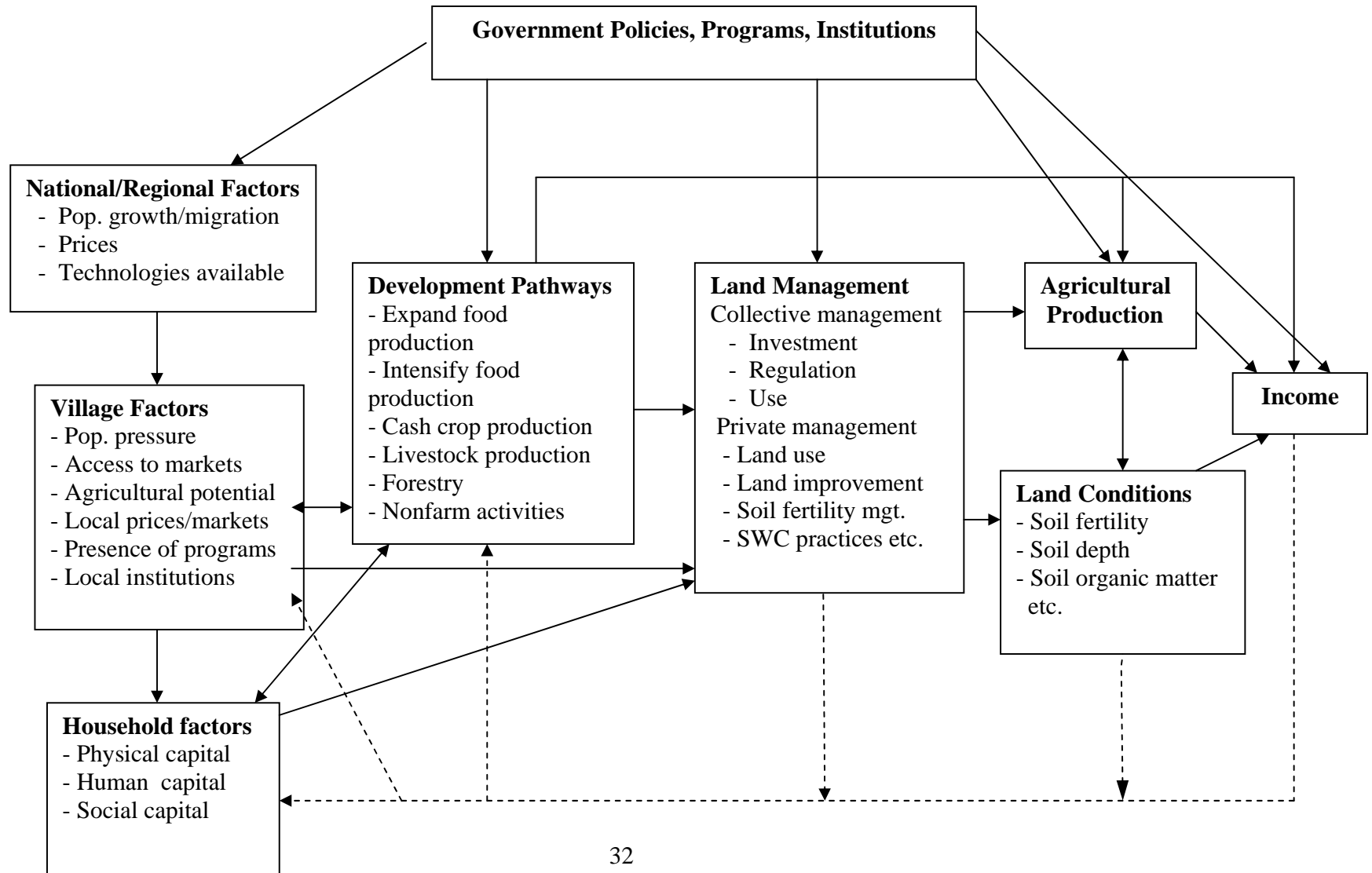
potential, access to markets, population density, and presence of government programs and organizations. These factors largely determine the comparative advantage of a location by determining the costs and risks of producing different commodities, the costs and constraints to marketing, and the opportunities and returns to alternative activities, such as farming vs. non-farm employment. These factors may have generalized village level effects on development pathways, such as through their impact on village level prices of commodities or inputs, or they may affect farm household level factors, such as average farm size. Household level factors such as households' endowments of physical assets (farm size, land quality, livestock, savings), "human capital" (education, training, farming experience), and "social capital" (cultural norms, family and ethnic relations) may also determine the development pathway pursued by particular households.

Government policies, programs and institutions may influence land management and its implications for productivity, sustainability, and household incomes at many levels. Macroeconomic, trade, and market liberalization policies will affect the relative prices of commodities and inputs in general throughout a nation. Agricultural research policies affect the types of technologies that are available and suitable to farmers in a particular agro-ecological region. Infrastructure development, agricultural extension, conservation technical assistance programs, land tenure policies and rural credit and savings programs affect awareness, opportunities, or constraints at a village or household level. Policies or programs may seek to promote particular development pathways (e.g., non-traditional export cash crop production), or may seek to address constraints arising within a given development pathway (e.g., credit needs arising in cash crop production). Programs may attempt to address land management approaches directly, for example by promoting particular soil fertility management practices. Policies and programs may also be designed to affect development outcomes directly, for example, through direct management of land by the government, nutrition or income enhancement programs.

Currently available information does not provide policy makers with much guidance as to which of these intervention points will be most effective in achieving better land management, improving agricultural productivity, and increasing incomes and food security. Much public action aimed at improving land management focuses on influencing household adoption of particular technologies. Yet this may be ineffective if the technologies are not suited to the development pathways that have potential in a given location. It may be more effective in many cases to first focus on the larger development strategies for particular development pathways, before focusing too much on particular land management technologies.

In the next section we identify the potential development pathways in rural Uganda and classify different regions of Uganda according to factors expected to determine the comparative advantage of alternative development pathways ("development domains"). We then consider which development pathways have most potential in different development domains. In the subsequent section, we present hypotheses about the appropriate strategies for sustainable development in these different domains, taking into account the development pathways identified.

Figure 6: Factors affecting Development Pathways, Land Management, and their Implications



6. Development Pathways and Development Domains in Uganda

In this section we consider hypotheses about which development pathways have potential in Uganda, and in which types of areas (development domains) these potentials are greatest.

Development Pathways in Uganda

There are many types of agricultural products and livelihood strategies that are important in Uganda, and still more have potential that has not yet been realized. To identify the potentials existing, it is useful to classify the different types of economic activities of rural people according to the type of occupation (i.e., crop production, livestock production, forestry, rural non-farm activities, and urban employment), the orientation of the activity (whether for subsistence or for cash, whether linked to agricultural production in the case of rural industry), the type of crops produced (whether annual or perennial), and the marketability of the product (whether the product is perishable or storable and high or low value relative to costs of transporting it to market) (Table 1).

The main subsistence perennial food crop produced in Uganda is matooke, while several annual food crops are also produced for subsistence purposes, including sorghum, millet, cassava, and sweet potatoes as examples. Many of these products are also (increasingly) produced for cash purposes, in which case the marketability of the products becomes relevant. Matooke is perishable and costly to transport relative to its value, due to its high water content. Thus cash crop production of matooke is expected to be more suited to areas of relatively good market access, where production conditions are suitable.¹⁰ Fruits and vegetables are highly perishable and thus must either be processed close to the farm level or produced close to markets. Many annual food crops, such as cereals and pulses, can be dried and stored for extended periods and are somewhat higher in value per unit volume than matooke; so can be produced further from markets. High value storable crops such as coffee and cotton may be profitable even far from markets, though they may also have a comparative advantage in areas of high market access.

Available estimates of domestic resource costs of production for different crops suggest that Uganda still has an international comparative advantage in its traditional export crops, including coffee, cotton (with use of improved technologies), tea and tobacco (NEMA, 1999).¹¹ Uganda also appears to have a comparative advantage in several non-traditional export crops, including cocoa, cashew nuts, pyrethrum, groundnuts and various vegetables and spices. It does not have a comparative advantage in maize for the world market, but does in the East African regional

¹⁰ Paradoxically, matooke production has been shifting from areas close to the urban market in Kampala to southwest Uganda. This is reportedly due to pest problems (especially banana weevils and nematodes) and soil fertility problems in the Lake Victoria crescent (Gold, et al., 1999), but higher returns to alternative uses of land and labor in this area may also be critical. These issues illustrate that other factors besides distance to market are also important determinants of the location of food production.

¹¹ The domestic resource cost (DRC) ratio is the ratio between the cost of producing and marketing a commodity (in units of local currency spent per unit of foreign exchange earned) and the exchange rate (local currency per unit of foreign exchange). A DRC ratio of less than one for a commodity implies that the country has an international comparative advantage in the commodity.

market. Uganda has a marginal comparative advantage in rice production for the regional market. These estimates depend of course upon prices in regional or international markets, which may turn against Uganda's competitiveness, but barring that, improvements in productivity and marketing efficiency are expected to increase Uganda's comparative advantages in most of these products (Ibid.).

These considerations of comparative advantage suggest potentials for several types of crop-oriented development pathways in Uganda. These include expansion and intensification of high value storable traditional export crops like coffee and cotton and non-traditional export crops like cocoa in areas with climate and soils suited to their production, expansion and intensification of perishable crops like fruits and vegetables in areas of high market access and sufficient rainfall, and expansion and intensification of maize for the regional market in areas with sufficient rainfall. Expanding and intensifying production of other bulky food crops for subsistence purposes or for the local market (e.g., matooke, cassava, sweet potatoes) may also be viable development pathways, even if Uganda does not have a regional or international comparative advantage, since such commodities tend not to be tradable over long distances. Such products may have potential as cash crops close to urban centers or for subsistence purposes in more remote areas. Whether the development pathways used for crops are extensive (involving mainly area expansion without significant intensification in use of labor or other inputs) or intensive will depend upon whether land of suitable potential is available for expansion, which depends upon population density and agricultural potential of particular areas, and the availability of suitable technologies for extensification or intensification.

Similar considerations apply to production of livestock and livestock products. Intensive production of perishable products such as dairy and fish farming are likely to be suited mainly to areas of high market access and high population density. Extensive production of high value livestock that are relatively easy to transport, such as cattle and small ruminants, can occur in areas far from markets, and tends to have a comparative advantage in areas that are low in potential for crop production. Dairy products may also be produced in such extensive systems in lower potential areas, but high access to collection and processing facilities or to urban markets is essential. Other animals such as pigs and poultry can be raised in many areas, but intensive production for the market is likely to occur mainly close to urban areas, due to economies of scale in production, relatively high costs of transporting them relative to their value, the perishability or ease of damage of some of the products (e.g., eggs) and the use of purchased compound feeds (especially for poultry). In areas where subsistence food production continues to be important (especially more remote areas of relatively high population density), mixed-crop livestock production is likely to continue (or may develop as population density rises in pastoral systems), with farmers keeping small numbers of animals for plowing, consumption purposes and as a form of savings. This is because the benefits of exploiting complementarities between crop and livestock production rise as population density rises, particularly where markets are not well developed (McIntire et al., 1992).¹²

¹² These changes can be affected by cultural views. For example, in Ankole farmers are reluctant to use cattle for plowing, preferring not to use them as "beasts of burden". The nature of the soil (i.e., how heavy or light) also affects whether animals can be used for tillage.

Forestry production is likely to be suited to areas of low population density, since land scarcity in high-density areas usually causes intensive food or cash crop production to have higher value and higher priority. Even in low-density settings, there are often conflicts between extensive livestock production and forest preservation (NEMA, 1999). Production of high value forest products such as timber or pine resin may be economical in remote locations (if suitable road and transport infrastructure exists), while low value products such as fuelwood must be produced close to markets, unless they are used only for subsistence purposes. Conversion of fuelwood to charcoal can extend the marketable range of fuelwood products, however.

Rural non-farm activities may also offer valuable livelihood opportunities. In most cases, rural employment activities are linked to agriculture. This includes industries processing agricultural commodities (e.g., coffee processing, cotton milling, sugarcane processing, leather tanneries), commodity traders, and individuals and firms providing agricultural inputs. Potential for development of these activities thus depends on agricultural development. These activities are also more likely to be significant sources of employment in higher population density areas close to urban centers and towns.

There are also potentials for rural people to be employed in rural non-farm activities that are not linked to agriculture, such as mining and construction, and in urban areas. Mining activities are presently very limited in Uganda and the overall potential is probably not very large, though there are a few places with notable mineral potential in southwest and southeast Uganda (NEMA, 1999). Construction is likely to be an important source of income in developing urban areas and towns. Urban employment is obviously potentially important mainly close to urban centers.

Classifying Development Domains

The preceding discussion demonstrates the importance of three types of factors in determining the comparative advantage of these development pathways in different locations: agricultural potential, access to markets, and population density. These factors can thus be used to identify different “development domains” in Uganda, each having somewhat different potentials in terms of feasible development pathways.

Agricultural potential is an abstraction of many factors—including rainfall, altitude, soil type and depth, topography, presence of pests and diseases, and others—that influence the absolute (as opposed to comparative) advantage of producing agricultural commodities in a particular place. There are of course variations in potential depending upon which commodities are being considered. Furthermore, agricultural potential is not a static concept but changes over time in response to changing natural conditions (such as climate change) as well as human-induced conditions (such as land degradation). For simplicity of exposition, however, we will sweep aside these important considerations and discuss agricultural potential as though it was a one dimensional and fixed concept. In reality, the multi-dimensional and dynamic nature of agricultural potential should be considered when developing more specific strategies of development than will be possible in this paper.

Access to markets is critical for determining the comparative advantage of a given location, given its agricultural potential. For example, a community with an absolute advantage in producing perishable vegetables (i.e., total factor productivity in vegetable production is higher there than anywhere else), may have little or no comparative advantage (low profitability) in vegetable production if it is far from roads and urban markets. As with agricultural potential, market access is also a multi-dimensional and dynamic concept (distance to roads, condition of roads, distance to urban centers, degree of competition, access to transport facilities, access to international markets, etc.), but we will treat it as a single predetermined variable (though subject to change through investments in roads, for example).

Population pressure affects the labor intensity of agriculture by affecting the land/labor ratio, and may also induce innovations in technology, markets and institutions, or investments in infrastructure (Boserup 1965; Ruthenberg 1980; Hayami and Ruttan 1985; Binswanger and McIntire 1987). Population pressure thus affects the comparative advantage of labor-intensive pathways of development, as well as returns to various types of investments. We take average population density as an indicator of population pressure, although one could argue that population density per unit of arable land would be a better indicator. Absence of comparable data on this latter indicator makes it difficult to use in practice, however. To some extent, differences in agricultural potential will account for differences in arable land per total area of land (i.e., the fraction of arable land is likely lower in areas with lower agricultural potential, controlling for population density).

These three factors interact with each other in complex ways. Population density tends to be higher where there is greater agricultural potential or greater market access, since people tend to move to such areas in search of better opportunities. On the other hand, population pressure may have contributed to land degradation, reducing agricultural potential from what it once was. Market access tends to be better where there is higher population density, since the per capita costs of building roads are lower and the benefits higher in such circumstances. Market access also tends to be better where agricultural potential is higher, since the returns to developing infrastructure are greater. Despite these interrelationships, there is still substantial independent variation of these factors in Uganda. Given such variations, and the fact that these factors change relatively slowly over time, it is useful to classify the regions of Uganda into different development domains, depending upon these three factors.

Development Domains in Uganda

We have classified agricultural potential in Uganda based on agro-climatic conditions and topography, considering production requirements for bananas as an indicator of potential for perennial crops and requirements for maize as an indicator for potential for annual crops. There is of course no typical crop, and one would ideally like to classify potential for each crop being considered separately. Such an exercise, though potentially useful, would not assist in developing a simple classification system and is beyond the scope of this paper. Despite this limitation, we expect that many perennials have relatively similar climatic requirements; this would seem to be true of coffee and bananas given their close association in Uganda. Similarly, many annuals require a similar length of growing period as maize. Thus, we expect the general

pattern of agricultural potential identified to hold for many other crops, although there are bound to be crop-specific variations.

Two important factors determining agricultural potential that are not incorporated into our classification are soil conditions and incidence of pests and diseases. Absence of reliable data for these variables for Uganda as a whole, and the high geographic variability of these variables (particularly soil conditions) precluded use of these variables in our general classification. Nevertheless, available information on soil types in Uganda suggests that there is a good deal of correlation of general soil types with the agro-climatic classification, with relatively better soils in the highland areas and in the Lake Victoria region, and more soil constraints as one moves northward (Ssali, 2000). Many important pest problems are also associated with different agro-climatic zones. For example, banana weevil and nematode problems are greater in the Lake Victoria region than in the southwestern highlands; which is one of the reasons for the shift in banana production out of the Lake Victoria region (Gold, et al. 1999). In the discussion below, we incorporate such qualifying considerations where relevant to the extent possible.

The agro-climatic potential for banana production is shown in Figure 7. Based upon the average length of growing period, average rainfall, maximum annual temperature, and altitude, we have identified seven zones within our study area: the high potential area bimodal rainfall area at moderate elevation (the Lake Victoria crescent), the medium potential bimodal rainfall area at moderate elevation (most of central and parts of western Uganda), the low potential bimodal rainfall area at moderate elevation (lower elevation parts of southwestern Uganda), the high potential bimodal rainfall southwestern highlands, the high potential eastern highlands, and the medium potential unimodal rainfall region at moderate elevation (parts of northern and eastern Uganda), and the low potential unimodal rainfall region at moderate elevation (much of northeastern Uganda). These categories indicate the agro-climatic potential for banana (and probably coffee) production (i.e., high, medium, low); though pests (mainly banana weevils and nematodes) are a serious constraint to banana production in much of the Lake Victoria region (Gold, et al., 1999). However, this problem may be more a result of poor management practices than a result of any greater inherent susceptibility of this region to such pests (Ibid.). Coffee wilt is reportedly more of a problem in western Uganda (NEMA, 1999).

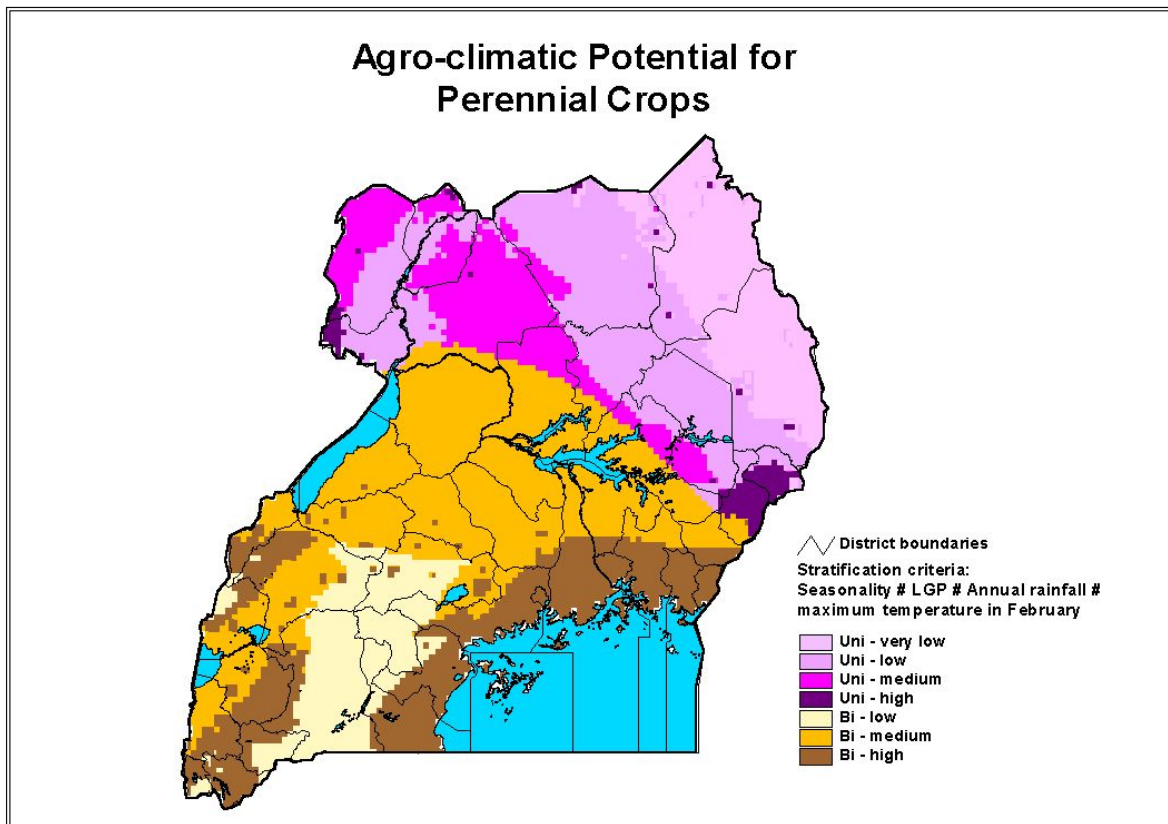
The map of potential for annual crops (not shown) is very similar to that for banana, although the implications of some of the regions are different. Annual crops require a sufficiently long uninterrupted growing season, which means that a unimodal pattern of rain is more favorable than a bimodal one, given the same length of growing period. Thus the unimodal medium potential zone likely has higher potential for (longer duration) annual crops than the bimodal medium potential zone, even though the length of growing period in these regions is similar (8-9 months). Most annual crop production is also suitable in the unimodal low (but not very low) potential region in Figure 7, since the length of growing period is six to seven months in this region. In our discussion below, we combine the unimodal medium and unimodal low regions, as we consider this region to be of at least medium potential for annual crops. The bimodal low potential zone is not suited for most annual crops, because the growing period is divided between two short rainy seasons. These considerations suggest that annual crops will have more of a comparative advantage in the northern and eastern regions (relative to perennial production those

zones), but annuals also have significant potential in the high and medium potential bimodal areas of south and central Uganda, and in the highlands.

These regions of Uganda were also classified according to the level of market access and population density. To classify market access, we used the measure of potential market integration estimated by Wood, et al (1999), which is a measure of travel time from any location to the nearest five towns or cities, weighted by the population of the towns or cities. Areas of high market access are mainly in the Lake Victoria region, the densely populated southwestern and eastern highlands, and parts of the north and west close to major roads and towns. Population density was classified based upon rural population density of parishes in 1991 (greater or less than 100 persons per square km., which is about the average rural population density in Uganda).

Overlaying these three dimensions of agricultural potential, market access and population density, we can classify different development domains of Uganda (Figure 8). There are 24 possible domains (combining the unimodal medium and low potential, though only 16 are represented to any significant extent in Uganda. Because of correlation among the other factors, some possible combinations do not occur. For example, it is difficult to find places with low market access and high population density (except in parts of the highlands) or high market access and low density (except in lower potential areas).

Figure 7. Agro-climatic Potential for Perennial Crops



Source: Gerd Ruecker, Center for Development Research, 2000

Figure 8. Development Domains in Uganda

Development Pathways in the Development Domains

Based on the types of livelihood strategies and their requisites discussed above, we have classified 20 possible development pathways in Uganda (Table 2). Six of these involve expanding crop production (annuals for subsistence, storable annuals for cash, perishable annuals for cash, perennials for subsistence, storable perennials for cash, and perishable perennials for cash), without significant intensification in use of labor or other inputs. Six of these involve intensification of crop or mixed crop-livestock production. One is expansion of extensive livestock production (cattle or small ruminants) while two involve intensive livestock production (dairy and other livestock—pigs, poultry, and fish farming). Two involve increased production of forestry products (high or low value). Two involve rural industry (linked or not linked to agriculture), and the final pathway is increased employment in urban areas.

The extensive crop and livestock strategies are expected to have comparative advantage mainly in low population density areas, while intensive strategies are appropriate to high density areas. Perishable crop and livestock products must be produced close to markets, while storable crops may be produced in areas of either high or low access. Perennial crops are expected to be suited more to the bimodal rainfall regions while longer duration annuals (such as maize) are suited to all regions except the bimodal low rainfall region (though having higher potential in the areas classified as high than those classified as medium or low). Forestry activities are expected to have comparative advantage mainly in low population density areas of at least medium rainfall, with low value products requiring good market access (if production is for cash purposes) while high value products may be produced in areas of either high or low access. Rural industry (whether or not linked to agriculture) will be most common in more densely populated areas close to markets and towns, while urban employment is likely common mainly close to Kampala.

Table 3 presents the development pathways hypothesized to have most potential in each development domain, based upon reorganization of the information presented in Table 2. More development pathways are possible in areas of high or medium agricultural potential than in areas of low potential, and in areas of high market access than in areas of low market access. Differences in population density are expected to determine mainly the labor intensity of the pathways pursued.

7. Potential Development Strategies

In this section, we discuss the likely opportunities, constraints, land management problems and options in different development domains, considering the development pathways that are being or may be pursued. We also develop hypotheses about the appropriate policy and institutional strategies to address the problems and constraints and achieve the potentials of these domains. Due to considerations of space, we discuss only on a few of the dominant zones accounting for most of the population and area of the study region.

High/Medium Potential Perennials Zone with High Market Access and Population Density

In areas having high or medium potential for perennials, good market access and high population density, the potential development pathways include intensification of perennial or annual cash crops (perishable or storable), intensive dairy and other livestock production, rural industry, and urban employment (especially close to Kampala). Such areas include the Lake Victoria region, most of the highlands, and higher rainfall parts of central and western Uganda close to roads and towns. These are the rural areas of highest economic potential in Uganda.

Development Pathways in the Zone

All of these development pathways are already being pursued to some extent within these regions. However, there are many opportunities for greater intensification. Most crops are produced with very little use of modern inputs such as improved seeds and fertilizers, with the exception of a few high value estate crops such as tea, sugarcane and flowers. As mentioned earlier, most crop yields are well below their potential with more intensive management. Bananas are produced with limited management effort in much of the Lake Victoria region, though more intensive management and much higher yields are found in newer banana producing areas in the southwest (Gold, et al., 1999). Adoption of clonal coffee and modern inputs in coffee production is still low. Use of improved breeds in livestock production is still very limited (NEMA, 1999).

Growth in domestic demand will be the driving force for growth in opportunities for staple food products, livestock products and perishable foods like fruits and vegetables. Production and consumption of milk is growing rapidly in Uganda, especially near Kampala, though milk consumption (about 20 liters per capita) is still very low by international standards, suggesting substantial potential for expansion as marketing channels improve and as urban incomes rise (NEMA, 1999). Demand for meat, fish and milk are fairly responsive to incomes, with a 1 percent rise in incomes leading to an increase in demand of between 0.5 and 1.0 percent (Walshe, et al., 1991; World Bank, 1998). Demand for perishable fruits and vegetables is also likely fairly responsive to income growth, though estimates of income elasticities are not available for Uganda. Demand for staple foods is less responsive to income growth, with a 1% increase in income generally leading to less than 0.2 percent increase in demand (World Bank, 1998). Thus as incomes rise and the urban population continues to grow in Uganda, the comparative advantage of these regions will shift more towards intensive production of dairy products, pigs, poultry, fish farming and other livestock and to perishable cash crops such as

fruits and vegetables, relative to staple food crops. This may be one of the underlying reasons for declining management effort and production of matooke in the Lake Victoria region; other activities (including non-farm activities as well as these other agricultural products) may simply be becoming more profitable.

Since the early 1990's, market liberalization has greatly improved the profitability of coffee production. Coffee producers now receive about 70 percent of the export receipts from coffee sales, compared to only about 20 percent in the late 1980's. These changes certainly increased the comparative advantage of the coffee producing regions of Uganda. Now that liberalization has been accomplished, however, changes in the international market will be the main driving force for changes in the comparative advantage of coffee. Recent declines in international coffee prices have reduced the attractiveness of coffee in Uganda, and many coffee farmers are investing in alternative assets such as livestock. Thus, unless international prices for coffee recover and continue to improve over time, the comparative advantage of coffee will decline relative to production of food for the local market (especially foods with high income elasticities, such as livestock products, fruits and vegetables). This shift is part of a more general tendency for the price of non-tradable goods and services to rise relative to the price of tradables, as per-capita incomes increase. Thus in areas of high agricultural potential, high market access and high population density, we expect that development associated with intensive livestock production and perishable cash crops to become increasingly important, though coffee production is likely to remain the dominant economic activity for the foreseeable future (barring a worsening problem with coffee wilt¹³ or other pests and diseases or continued decline in world coffee prices), given that Uganda still has a strong comparative advantage in coffee production (particularly of clonal robusta and arabica coffee) (NEMA, 1999) and large investments sunk in this activity.

Development opportunities in the rural non-farm sector will be strongly linked to the agricultural development pathways. One general trend in food consumption as incomes grow and populations become more urban based is an increase in demand for processed foods. Thus, opportunities will be growing in processing of staple food items such as maize and cassava as well as in dairy collection, processing and marketing; animal feeds, meat and hide processing; and fruit and vegetable trading and processing. Upgrading of facilities for processing and marketing of export crops may also contribute to growth, though most of the growth is likely to be in other areas.

Constraints

The main constraints to development in these high potential, high access regions are likely to include limited farmer awareness of appropriate management practices and marketing opportunities for non-traditional cash crops such as fruits and vegetables and intensive livestock production and fish farming; limited supply of improved seeds of non-traditional crops and improved breeds of livestock; limited supply of fish fry and fingerlings for fish farming; limited access to credit for small scale producers to be able to invest in production of such products; high costs of transport (due in part to high taxes on fuel), and limited development of storage,

¹³ It should be noted that coffee wilt has been an increasing problem in Uganda, however, and that farmers are realizing that clonal coffee is not resistant to the wilt, as was once thought by many.

transport, processing and marketing facilities for many of these non-traditional products. Some of these limitations likely also apply to production of traditional crops such as coffee and bananas, particularly limited awareness about improved varieties and access to credit. Problems of pests and diseases, and high costs of labor may be even larger problems for these traditional crops. However, as mentioned earlier, the declining management intensity and concerns about labor costs for these crops may be simply a reflection of their declining comparative advantage.

Land Management Problems and Options

The major land management problems in these regions are soil fertility depletion and, in annual crop systems in the highlands, soil erosion. There are many opportunities for improved land management. In areas where high value vegetable crops are being adopted, there is high potential for use of inorganic fertilizers, since the returns are likely to be high. There is also potential for use of manure produced from intensive livestock operations as a source of soil fertility for such crops, when such livestock operations are located relatively close to where these cash crops are produced. Another potential valuable use of livestock waste is as a source of nutrients in fish farming. Agroforestry potentials include fruit trees and trees for poles and timber in home gardens and plot boundaries, and multi-purpose trees planted on hillside grazing areas (Aluma, et al., 1988). Other organic methods of soil fertility management, such as composting and mulching, may have potential in farmyard gardens where local wastes are used to enhance productivity of higher value crops. However, such practices are not likely to be extensively practiced due to their high labor requirement and costs, and limited potential for market exchange of organic inputs due to their bulkiness. In the highlands, physical measures of soil conservation are falling into disrepair in many places, probably due in part to the rising value of labor and the high degree of land fragmentation. In such areas, less labor-intensive biological approaches to soil conservation such as keeping fallow strips are more likely to be adopted (Critchley 1998). Promoting planting of high value perennial crops instead of annual crops on steep slopes may be an effective way of reducing erosion while increasing farmers' incomes. Promoting intensification of production of annual crops in valley bottom lands (for example, paddy rice in swampy areas) may be an essential complement to promoting less production of annuals on the steep slopes. On the other hand, however, there are fears that paddy production may contribute to pollution or drying up of wetlands if sustainable practices are not used, and paddy production in wetlands is being opposed by NEMA and local authorities in some areas. The possibility of sustainable paddy production in wetlands deserves further study.

Possible Technology and Policy Strategies

Considering these opportunities and constraints, some policy priorities can be suggested as hypotheses for further study. Investments in research and extension focusing on non-traditional crops and livestock products with high profit potential will be critical. Extension efforts are more likely to be successful if they focus first on increasing farmers' profits and less on promoting labor-intensive land management practices that do not show demonstrable short-term returns. Where possible, soil fertility management and soil conservation practices that yield higher returns to the farmer's effort should be promoted. In many cases (especially in steeply sloping lands), this may be done by "stealth" by emphasizing measures that improve infiltration of water into the soil and reduce runoff, rather than measures to conserve soil *per se* (Shaxson,

1999). Where more labor-intensive methods are still necessary to prevent major degradation, they should be promoted as part of a larger package designed to increase profitability, and probably only after the extension program has demonstrated success in improving profits, and thus earned the farmers' confidence.

Extension and technical assistance messages with regard to use of fertilizer may need to be clarified. Farmers may be confused by the conflicting messages they sometimes receive from different programs and non-governmental organizations. Fertilizers may be promoted as a complementary part of an overall strategy of integrated land management, rather than as a substitute for other land management practices to maintain soil organic matter, improve soil physical structure, etc. Little recent information is presently available on crop response to fertilizer (most information is from the 1960's) for different crops; more information on responses to fertilizer in combination with other land management technologies is needed if farmers are to be able to make informed choices among the options that they face.

Extension efforts may also be more effective if they provide farmers with information about the likely profitability of different non-traditional cash crops. Collection and dissemination of market price information on such products may also be very helpful. Provision of such information is an important role for government, since it is difficult for private agents to profit from providing such information (especially to small farmers) because of the difficulty of excluding those who do not pay for the information from receiving it. Such information is a classic example of a public good, and the government of Uganda should seriously consider its role in providing it. To be most helpful, such information should be available on a regular basis and widely disseminated, through radio as well as print media.

Increased availability of improved crop varieties is necessary if farmers are to capitalize on the potential demand growth for these. Since improved crop seeds are complementary to fertilizer use (i.e., they increase the return to fertilizer use), increases in use of such seeds will promote increased fertilizer use for soil fertility management. The Uganda Seed Project (USP) is involved in production and multiplication of a wide variety of seeds (mainly cereals, pulses and oilseeds), but its capacity is limited and there are problems in the distribution system. Sasakawa-Global 2000 (SG2000) has contributed to seed distribution in recent years by establishing a network of stockists and resellers, but it is still limited by the capacity of USP. Investments to increase the capacity of USP will be important to meet growing demand in the near term. In the longer term, greater involvement of the private sector in seed production and distribution is needed. Development and privatization of Uganda Seeds Ltd., as envisioned by the Agricultural Seeds and Plant Statute of 1994, may help to solve the problem (APSEC, 2000). Involvement of international seed firms may be limited by the small market at present, and this may be overcome as adoption increases. One possible disincentive to private investors in seed research, production and marketing is the fact that Uganda lacks a plant variety protection law (Ibid.); this may need to be addressed to encourage greater private involvement.

The availability of improved seed for coffee appears to be less of a constraint. The main problem with improved clonal coffee is limited adoption by farmers, rather than limited seed availability. Multiplication and distribution of improved mosaic resistant cassava has been a

major success story, with a large campaign and widespread involvement of farmers from the beginning. This may offer a model for dissemination of an effective improved variety.

The quality of seeds must also be assured. A statute providing for establishment of the National Seed Board (NSB) to regulate and certify seed quality has been enacted, but the Board is not yet operational. The effectiveness with which the NSB carries out these functions will be an important determinant of private market development in the seed industry.

Investments are needed also in improving the quality of the livestock herd. Adoption of improved breeds is less than 5 percent for cattle (NEMA, 1999). Due to limited investment in livestock research and extension (less than 1% of research and extension expenses), there has been little attempt to improve local breeds (Ibid). Improved breeds are likely to be especially important in achieving the potential of intensive livestock activities like dairy, pig and poultry production, where adequate feed, water and veterinary care may be more available than in more extensive or subsistence livestock systems. However, the high costs of exotic breeds (often 8 to 10 times the price of a local breed) may make them unprofitable or, even if potentially profitable, a large risky investment that is difficult for a small farmer to finance. Greater investment by the government in breeding improved livestock may help to ease the supply constraint and reduce the high cost of such animals. Beyond this, development of credit facilities for livestock loans will likely be quite important to facilitate such investments. Improvements in animal husbandry practices (especially feeding and veterinary care) will also be critical to realize the potential returns from improved breeds.

The supply of fish fingerlings for fish farming is very limited, due to the dilapidated state of the fish fry centers operated by the Fisheries Research Institute (FIRI) (Ibid.). Investments have been made to expand capacity with assistance of the World Bank, but capacity is still very limited. This, together with high investment costs to establish fishponds and to acquire nets, and competition from poorly regulated natural fisheries in Lake Victoria and elsewhere, may limit the growth of aquaculture among small farmers. Investments in increased capacity to produce fingerlings and development of credit facilities will likely be important.

As mentioned above, limited access to credit or savings is likely a major constraint to small farmers adopting use of purchased inputs such as fertilizer or investing in improved livestock. Given the government's desire not to become directly involved in the provision of credit, its options to directly address the problem may be limited. However, it may indirectly promote development of the rural credit system through measures to help lenders improve loan recovery. Implementation of the 1998 Land Act, especially provisions for registering land held under customary tenure and promoting acquisition of mailo land by bona fide occupants, may help to stimulate the development of credit markets by providing potential borrowers a valuable form of collateral. Other measures that could help to promote development of the rural financial system would be to amend the Financial Institutions Statute of 1993 to provide a more appropriate regulatory framework for micro-finance institutions (MFI's) and to invest in capacity building of MFI's (APSEC, 2000). Beyond increasing the capacity of such institutions to raise capital, provide credit, and monitor repayment, governments at different levels may help to reduce enforcement costs by developing expedited legal procedures to ensure repayment.

At least as important as increasing farmers' access to credit for profitable investments is promoting a culture of savings and a serious attitude towards credit. If credit is too easily given without adequate efforts to enforce repayment, farmers may continue to view credit as a form of grant, and the financial system will not develop. Rural households must also be convinced of the viability and reliability of financial institutions before they are willing to put their savings there. Developing such attitudes will take time, educational efforts, a cautious approach to credit, and adequate government regulation of financial institutions. One factor that inhibits the development of financial institutions is the negative real rate of interest on deposits that is common. A continued low inflation rate will help to limit this problem by limiting the inflation "tax" on required non-interest bearing reserves of banks (McKinnon, 1973). Reducing reserve requirements, to the extent consistent with prudent banking practices, can help to reduce this tax further. However, the large spread between lending and deposit interest rates is mainly due to the high transaction costs of dealing with small depositors and borrowers and to problems of loan recovery. Thus, development of cooperatives, group lending schemes, alternative forms of collateral, and lower cost enforcement mechanisms are likely to be critical to increasing savings interest rates and reducing loan costs, and ultimately bringing about greater savings and investment in rural areas.

Improvements in infrastructure and the marketing system are also critical if farmers are to realize the potential of many of the development pathways suitable to this development domain. Substantial investments have been made in rehabilitating the main road network in recent years, though deficiencies remain. The density of rural feeder roads is high in the high potential, high market access areas being considered here, and nearly all villages in this region have access to a road. The issue of concern is more one of road quality and maintenance, since many of these roads are not readily passable by vehicles during the rainy season. Investments in improving, rehabilitating and maintaining rural feeder roads through the Rural Feeder-Roads Infrastructure Programme and planned under the Agricultural Modernization Plan will help to reduce transport costs and (probably more importantly) help to assure year-round access to markets, which is critical for production of perishable commodities. Local councils are generally placing high priority on investments in rural roads, so the decentralization policy appears to be helping to improve the situation.

Other constraints in the marketing system include lack of adequate storage facilities, limited availability of electricity for cold storage of perishable products, limited ability of farmers to store and market products due to lack of credit or savings, limited organization of farmers' cooperatives and limited capacity of those that exist, and limited development of processing facilities (NEMA, 1999). Most of these constraints are the responsibility of private individuals and firms to address, though government can help to facilitate this by taking steps to improve the rural financial system, help to build capacity of farmers' organizations, promote rural electrification (especially where significant potential for rural industry exists), and attracting foreign investors in agricultural processing and marketing industries.

To summarize, there are many investments and activities needed to relax the constraints and realize the potential of the market-oriented development pathways having potential in the high potential areas with good market access and high population density. Most of these investments and activities will be the responsibility of private individuals and firms, but there will still be a

critical role for complementary government actions at different levels. Foremost among the priorities are likely to be investments to improve rural feeder roads, agricultural extension, seed and livestock breed availability, and the capacity of the rural financial system. Land management can be expected to improve if farmers are made more aware of profitable and sustainable land management options by the extension system and other technical assistance programs, and become more able to finance use of fertilizer and other inputs as part of a broader approach emphasizing integrated soil water and nutrient management.

Medium Potential Annuals Zone with High Market Access and High Population Density

This zone is represented by areas of northern and eastern Uganda close to towns and major roads (e.g., parts of Kumi, Soroti, Lira and Apac). Many of the development pathways that have comparative advantage in the previously discussed zone likely also have comparative advantage in this zone, including intensification of annual cash crops, increased intensive dairy production, other livestock production, and rural industry linked to agriculture. Pathways related to perennial crop production such as bananas and coffee will have lower potential in this region than the central region due to lower rainfall and growing period. Nevertheless, there still is some potential for perennials in this zone, and some projects are promoting coffee or fruit production in parts of the zone.

These areas also likely will have more limited opportunities for non-farm development than areas closer to Kampala, and will face difficulty competing in the large Kampala market for dairy, livestock products, and perishable vegetable production, due to the large distance from that market. Thus, though there is potential for some development of these economic activities to serve the local consumer market in the north and east, these are unlikely to become dominant development pathways in this region. The most important development pathway is likely to be intensified production of readily storable and transportable annual crops such as cotton, cereals, pulses and oilseeds, with rural non-farm activities linked to these crops also being important in the towns of the region. Livestock also play an important role in these annual crop systems as a source of draft power (due to the light soils in the region), milk and meat products for home and local consumption, and as a store of wealth. Cattle theft by pastoralists from the northeast has been a major problem affecting parts of this region, and is undermining the viability of mixed crop-livestock production in such locations. The government has responded to this problem by supporting restocking efforts and by arming farmers to defend themselves against cattle thieves.

Many of the same kinds of constraints that limit development in the southern and mountain regions likely also affect the annual crop systems in this zone, including limited farmer awareness of appropriate management practices for new crops, limited supply of improved seeds; limited access to credit for small scale producers; and limited development of storage, transport, processing and marketing facilities for non-traditional products. Problems of limited farmer awareness are probably less important for traditional crops like cotton and millet than for more recently introduced crops. Marketing infrastructure for cotton had fallen into disrepair from the decline of the cotton industry in the 1980's, but reinvestment has been occurring in this industry. The reduced stock of animals (due to theft) and declining quality of grazing areas for oxen are serious problems affecting the potential for oxen for draft power. Tractors are a potential alternative source of draft power, but high initial costs, high fuel costs, and smaller

farm sizes in more densely populated areas cause them to be uneconomical or beyond the financial capability of most small farmers. In less densely populated areas of the northeast where farm sizes are larger and cattle theft is severe, there may be potential for adoption of tractors (especially in areas with heavier soils), though this may depend upon the availability of credit to finance such a large investment.

The land management problems in this region include soil fertility depletion as a result of declining fallow and limited application of fertilizer or organic material, and soil erosion (both water and wind). Plowing of the light soils prior to the annual rains leads to significant problems of water erosion, while uncontrolled bush burning in some parts of the region leaves soils exposed to wind erosion during the dry part of the year, as mentioned earlier.

There may be significant potential for adoption of fertilizer in parts of this region, which is believed by some soil scientists to be among the most responsive region to fertilizer inputs, particularly for improved varieties of maize and beans that are fertilizer responsive. Use of improved fallows, green manures, cover crops, and other means of maintaining soil cover while improving soil fertility may also have significant potential. Agroforestry potentials include rotational alley cropping; use of upper story trees around annual plots for fruits, poles and fuelwood; establishing fodder banks in small plots; planting live fences around farm plots and fodder banks; and planting multi-purpose trees in communal grazing areas (Aluma, et al., 1988). Where intensive livestock production is occurring, available supplies of manure can contribute to improved soil fertility management as well.

Policy priorities for the region probably should center upon intensification of cotton using improved methods, continued rehabilitation of the cotton processing and marketing industry, and adoption and intensification of improved storable annual crops that respond well to fertilizer inputs, such as maize and beans. Soil fertility and erosion problems can be addressed by emphasizing integrated nutrient management approaches in research and extension programs, incorporating methods that maintain as much soil cover as possible during critical erosive periods of the year. Achieving the potential will require research into response of crops to fertilizer and other management technologies, widespread dissemination of appropriate extension messages emphasizing the potential of such technologies together with use of improved seeds, investments in increased capacity to produce and multiply improved seeds for such crops, and efforts to foster development of the rural financial system to enable farmers to finance purchase of modern inputs, invest in storage facilities, and store and market their products for the best possible price. The policy approaches to meet these needs have already been discussed. An important additional need is for the government to continue efforts to control the problem of cattle theft and assist in restocking. With appropriate investments, this region can become a much larger source of foreign exchange (especially through increased cotton and maize production) and food for Uganda.

Medium Potential Perennials Zone with Low Market Access and Low Population Density

This zone is represented by most of central and much of western Uganda further from main roads and towns. In this area, there is potential for expansion of production of storable, relatively high value crops such as cotton and coffee. Subsistence production of food crops is also likely to

remain important, given the limited access to market and available land. Since access to market is low and land is available, the degree of intensification will likely remain low for some time, except perhaps in cash crop production. Land is also available for extensive production of cattle and small ruminants; however, water availability may be a limiting factor. Production of high value forest products also may be an important economic strategy in parts of this region, especially in higher rainfall areas to the west.

The constraints to development in this region relate mainly to the availability of infrastructure (especially roads), labor, water, land tenure and conflicts over land use, and diseases and pests. Limited road availability implies that cash crop production is limited to higher value, storable crops, while low population density means that labor constraints will likely limit the labor intensity of production, especially in food production. Limited available water sources for animals together with changing land tenure and land use patterns (i.e., settlement and crop production or ranching on land formerly available for transhumance by pastoralists) leads to potential conflicts between livestock producers and crop producers. Conflicts may also arise among crop producers, livestock producers and those involved in forestry activities over use of forest and woodland areas. Crop and livestock producers may seek to remove forests to expand their activities, reducing the potential for forestry activities. Tsetse fly infestation is a constraint to livestock production in the western part of the region, and another source of possible conflict between livestock production and preserving forests/woodlands, since tsetse control may require removal of tree species that provide habitat for the fly (Aluma, et al., 1988).

The major land management problems in the region include overgrazing (especially in heavily used areas close to water sources), deforestation, soil erosion in sloping areas planted to annual crops, and soil fertility depletion in areas where cash crops are being produced and fallow periods are not sufficient. There are many potentially useful agroforestry interventions in this zone, including planting multipurpose trees in private grazing areas, use of live fences, planting windbreaks around banana fields, use of upper story trees in crop plots and on boundaries, improved fallow, and keeping fallow strips along contours in hilly areas (Ibid.). Fallowing is likely to remain an important means of managing soil fertility for some time in this zone, given the low population density. Nevertheless, declining fallow periods as population increases and export of soil nutrients in cash crop production implies that some use of fertilizer and/or manure, together with agroforestry methods and crop rotation, will be increasingly needed to maintain soil fertility. The potential for use of fertilizer is greater on cash crops, while use of manure and agroforestry practices will likely have greatest potential in home gardens. Fallowing and crop rotation are likely to be the primary soil fertility management practices in annual crop plots.

Policy priorities in this region should probably focus on road development, addressing land tenure and conflicts over water and land use, and promoting less labor-intensive sustainable land management practices together with limited use of fertilizer for cash crops. As road investment and increasing settlement occurs, the potential for conflicts over access to land, water and forests will increase. The needs of pastoralists to have access to grazing lands and water sources should be considered when investing in roads and promoting settlement in areas used by pastoralists. Investments in water sources for animals (and people) will be important. Keeping public easements to water sources where land is being privatized is also important to consider. Improving collective action in managing communal grazing lands and woodlands may also be a

priority. Clarifying the rights and responsibilities of local councils in regulating and managing such resources may be helpful in promoting improved management. Greater authority for management at the lowest level consistent with protecting the interests and rights of pastoralists may be needed, since this will increase the ability and incentive of local authorities to manage the resources for the benefit of the community. Extension and other technical assistance programs should focus on methods of soil and water management that are not labor intensive, and which yield products of value locally. Many of the agroforestry practices suggested above may be useful in this regard. There may also be potential for expansion of coffee production in this zone; promoting clonal coffee may be more successful in areas of suitable potential where land is more available than in the densely populated Lake Victoria region.

8. Summary and Conclusions

In this paper we have found that soil fertility depletion and soil erosion are the main degradation problems in Uganda and that these problems are affected by relatively well-understood proximate causes and by a complex set of underlying factors and policies. We have presented a conceptual framework to sort through this complex set of factors and argued that appropriate policy strategies for sustainable development and improved land management in Uganda depend upon the pathways of development that have comparative advantage in a given location. We argue that the comparative advantage of development pathways is largely determined by three factors—agricultural potential, access to markets and population pressure. Based upon differences in these factors, we identified several development domains in Uganda, where different development pathways may be suitable. For a few of the major development domains, we have identified hypotheses about the key opportunities, constraints, land management problems and options, and suggest possible priorities for development strategies in these regions.

Generally, the strategies for areas of high potential and good market access need to focus on research and extension approaches that improve profitability and land management without reliance on overly labor-intensive methods, improvement and maintenance of rural feeder roads, increasing availability of improved seeds and livestock breeds and developing the capacity of the rural financial system. In areas of moderate potential for annuals and good market access, many of the same priorities will be important, though less emphasis should be given to perishable crops and more to storable products like cotton, cereals, pulses and oilseeds. In areas of moderate potential but poor market access (which are generally of low population density), possible priorities include investments in infrastructure (especially roads and water sources for animals); addressing potential conflicts over access to land, water and forests; increasing the responsibility of local governments for sustainable management of common resources; and promoting sustainable land management practices that are not highly labor intensive.

It is important to emphasize that these are only hypotheses, based upon theoretical considerations and a limited amount of empirical evidence. Furthermore, there is certainly substantial variation within the broad types of situations discussed, and across households having access to different resource endowments. Addressing problems of poverty, low agricultural productivity and resource degradation will therefore require strategies that address the needs of the poor as well as

the more well-endowed. Nevertheless, identifying the broad strategies of development that are feasible can help to identify and recommend targeted strategies for specific situations. Making recommendations about specific strategies will require more detailed information about the costs and benefits of alternative strategies in different situations, the priorities and concerns of key stakeholders, and other factors that will determine the likely success or failure of such recommendations. Policy research is needed to address these issues.

References

- Achan, P., M.M. Tenywa, M.I. Isabirye, R. Lal, and A. Lufafa, 1999. "Soil and Water Conservation in a Banana Based Cropping System Within the Lake Victoria Basin," In: Zake, J.Y.K., J.K. Tumuhairwe, C. Nkwiine, and S. Sessanga. *Soil Science, a Key to Sustainable Land Use*, Proceedings of the 17th Soil Science Society of East Africa (SSSEA) Conference held in Kampala Uganda, September 6 – 10, 1999. p. 149.
- Agricultural Policy Secretariat. 2000. Characterization of policies and institutions affecting land management in Uganda.
- Ahmed, R., and C. Donovan. 1992. Issues of infrastructural development: A synthesis of the literature. Washington, D.C.: International Food Policy Research Institute.
- Bagoora, D.F.K. 1990. "A Preliminary investigation into the Consequences of Inadequate Policies on Steeps of Ruhiga Highlands, Southwestern Uganda," In: Thomas, D.B. (ed); *Soil Erosion and Water Conservation in Kenya*. Department of Agricultural Engineering, University of Nairobi.
- Bagoora, F.D.K. 1988. Soil erosion and mass wasting risk in the highland areas of Uganda. *Mountain Research and Development* 8(2/3): 173-182.
- Baland, J-M., and J-P. Platteau. 1996. Halting degradation of natural resources. Is there a role for rural communities. Oxford: Clarendon Press.
- Bashaasha, B. 2001. The evolution and characteristics of farming systems in Uganda. Makerere University. Mimeo.
- Bazaara, N. 1994. Land Policy and Evolving Forms of Land Tenure in Masindi District, In Uganda Studies in Living Conditions, Popular Movements and Constitutionalism; Edited by Mahmood Mamdani and Joe Oloka Onyango. Vienna, JEP and Center for Basic Research.
- Bekunda, M. A. and Woome, P. L. 1996. Organic Resource Management in Banana-Based Cropping Systems of the Lake Victoria Basin, Uganda. *Agriculture, Ecosystems and Environment*. Vol.59: 171-180
- Bekunda, M.A. and J.K. Lorup, 1994. "Quantitative Assessment of the Impact of Soil Erosion on the Water Resources in Uganda" In: Kwakaikara, M.C., S. Mateete, A. Bekunda and T.S. Tenywa (eds). *Proceedings of the the 14th Conference of the Soil Science Society of East Africa*, 21 – 25 November, 1994 Mbarara Uganda. Pp 25 – 28.
- Besley, T. 1995. Property rights and investment incentives. *Journal of Political Economy* 103 (October): 913-37
- Boserup, E. 1965. *The conditions of agricultural growth*. New York: Aldine Publishing Co.

- Brett, E. A. 1995, Institutional Theory and Social Change in Uganda: In Harris, John Hunter, Janet Lewis, Colin M., eds.. *The new institutional economics and third world development 200-214.*: Routledge London and New York
- Bruce, J. 1986. Land Tenure Issues in Project Design and Strategies for Agricultural Development in sub-Saharan Africa. LTC Working Paper No. 128, Madison-Wisconsin.
- Chenery, E. M. 1960. An Introduction to the soils of the Uganda protectorate. Mem. Res. Div. Dep. Agric. Uganda, Series 1, No.1.
- Chhibber, A. 1988. Raising agricultural output: Price and non-price factors. World Bank Publications, Finance and Development. Washington, D.C.: World Bank.
- Deininger, K. and Okidi, J. 1999. Determinants of Agricultural Productivity and Non-farm Enterprise startups: The case of Uganda. A paper presented at a conference on assessing outcomes in the context of the comprehensive Development Framework held in October 1999 at Kampala, Uganda.
- Ehui, S 1995. Economic factors and policies encouraging environmentally detrimental land use practices in Sub-Saharan Africa. *In Proceedings of the 22nd international conference of agricultural economists*, ed. G.H. Peters and D. Wedley. Dartmouth.
- Ervin, C.A. and Ervin, D. E., 1982. Factors affecting the use of soil conservation practices: Hypotheses, Evidence and Policy Implications. *Land Economics* 58(3): 277-292
- Food and Agriculture Organization of the United Nations (FAO). 1999. Uganda Soil Fertility Initiative: Draft Concept Paper. Investment Centre Division, FAO/World Bank Cooperative Programme, Rome. Mimeo.
- Food and Agriculture Organization of the United Nations (FAO). 1989. FAO/UNESCO Soil Map of the World. Revised Legend. World Soil Resource. Report No. 60. FAO, Rome. Reprinted as technical paper 20, ISRC, Wageningen, 138 pp.
- Gold, C.S., E.B. Karamura, A. Kiggundu, F. Bagamba, and A.M.K. Abera. 1999. *International Journal of Sustainable Development and World Ecology* 6(1): 45-59.
- Government of Uganda (1998). Towards a Sector-wide Approach: Developing a Framework for the Modernization of Agriculture in Uganda. Ministry of Agriculture Animal Industries and Fisheries, Entebbe, and Ministry of Finance, Planning and Economic Development, Kampala, Uganda.
- Holden, S., B. Shiferaw, and M. Wik. 1996. Poverty, credit constraints, and time preferences: Relevance for environmental policy. Unpublished paper, Agricultural University of Norway.

- IFDC (International Fertilizer Development Center). 1999. *The Fertilizer Market Assessment and a Strategy for Development*. Consultancy Report Submitted to Sasakawa-Global 2000 and USAID Uganda, 40 pp.
- de Janvry, A., Fafchamps, and E. Sadoulet. 1991. Peasant household behavior with missing markets: Some paradoxes explained. *The Economic Journal* 101:1400-1417.
- Jones, E. (1992). Principles for Using Ferrallitic Soils in Uganda: *Experimental Agriculture*, Vol. 8:315-333.
- Kafureka, L. B. M. 1992. The Dynamics of the Land Question and its Impact on Agriculture in Mbarara District in Uganda. Working Paper No. 25, CBR Publications, Center for Basic Research.
- Kanabahita, C.. 1995. "A Land Evaluation of the Bwindi Buffer Zone for Agricultural Land Use Planning and Management," In: Tukahirwa, J.M. 1999. *Diagnostic and Characterization Studies Conducted from 1945 to 1995 in Southwest Uganda*. The African Highlands Initiative (AHI) Technical Report Series No. 10:13
- Kasenge, V. 1998. Socio-economic Factors Influencing the Level of Soil Management Practices on Fragile Land. Department of Agricultural Economics, Makerere University.
- Kisamba-Mugerwa, W. 1995. The Impact of Individualization on Common Grazing Land Resources in Uganda. Unpublished Ph.D. Thesis, Makerere University
- _____. 1992. Rangeland tenure and resource management: An overview of pastoralism in Uganda. Makerere Institute of Social Research (MISR).
- LaFrance, J. T. 1992. Do increased commodity prices lead to more or less soil degradation? *Australian Journal of Agricultural Economics* 36(1):57-82.
- Larson, B.A., and G.B. Frisvold, 1996. Fertilizers to support agricultural development in Sub-Saharan Africa: What is needed and why? *Food Policy* 21(6): 509-525.
- Lindblade, K., J.K. Tumuhairwe, G. Carswell, C. Nkwiine, D. Bwamiki. 1996. More people, more fallow: Environmentally favorable land-use changes in southwestern Uganda. University of Michigan, Population-Environment Fellows Program, Ann Arbor. Mimeo.
- Lufafa, A., M.M. Tenywa, M. Isabirye, and P.L. Woome. 2000. *Mapping Soil Erosion Using USLE and GIS in a Selected Banana Based Microcatchment of the Lake Victoria Basin, Uganda* (Unpublished).
- Lufafa, A., M.M. Tenywa, M. Isabirye, and R. Lal, 1999. "GIS Application to Soil Erosion Modeling in a Banana Based Cropping System in the Lake Victoria Basin," In: In: Zake, J.Y.K., J.K. Tumuhairwe, C. Nkwiine, and S. Sessanga. *Soil Science, a Key to Sustainable Land Use*, Proceedings of the 17th Soil Science Society of East Africa (SSSEA) Conference held in Kampala Uganda, September 6 – 10, 1999, p. 150.

- Magunda, M.K. 1981. *A Study of the Effects of Crust Formation on Germination and Means of Improvement*, M.Sc. Thesis, State University of Ghent, Belgium, pp 65.
- Magunda, M.K. and M.M. Tenywa. 1999. *Soil and Water Conservation*, Kawanda Agricultural Research Institute and Makerere University Staff Report, Uganda.
- Magunda, M.K., W.E. Larson, D.R. Linden; and E.A. Water, 1997. "Changes in Microrelief and their Effects on Infiltration and Erosion During Simulated Rainfall," *Soil Technology*, 10(1997):56-67.
- Majaliwa, M. 1998. *Effect of Vegetation Cover and Biomass Development on Soil Loss from Maize Based Cropping Systems*. Unpublished M.S. Thesis Makerere University.
- Makerere Institute of Social Research (MISR) and Land Tenure Center (LTC). 1989. *Land Tenure and Agricultural Development in Uganda*.
- Mamdani, M. 1992. *Class Formation and Rural Livelihoods: A Ugandan Case Study* in Bernstein et al. Oxford University Press, Oxford.
- McKinnon, R.I. 1973. *Money and Capital in Economic Development*. Brookings, Washington, D.C.
- Miuro, R. 1997. *Factors Affecting the Sustainability of Terraces in Kabale District*. Unpublished M.Sc. Thesis, Makerere University.
- Ministry of Finance and Economic Planning (MFEP), Republic of Uganda (1995). *Food Security and Export Statistics*. Export Policy Analysis Unit (EPAU). Kampala, Uganda.
- Ministry of Finance, Planning and Economic Development (MFPED), 1997. *Report on Economics of crops and livestock production*. Agricultural Policy Secretariat.
- Ministry of Finance, Planning and Economic Development (MFPED), Republic of Uganda (1998) *Poverty Trends in Uganda (1992-1996)*, Discussion Paper N0.2, Kampala, Uganda.
- Ministry of Finance, Planning and Economic Development (MFPED), Republic of Uganda (1997) *Report on Economics of Crops and Livestock Production*. Agricultural Policy Committee, Kampala, Uganda.
- Ministry of Finance, Planning and Economic Development (MFPED), Republic of Uganda (1999) *Report on Economics of Crops and Livestock Production*. Agricultural Policy Committee, Kampala, Uganda.
- Ministry of Planning and Economic Development, Republic of Uganda (MPED).1997. *Poverty eradication action plan*. Volume 1. Final Draft. June. Kampala, Uganda.
- Ministry of Planning and Economic Development, Republic of Uganda. 1996.

- Ministry of Planning and Economic Development, Republic of Uganda. 1995. Background to the Budget (1995/96).
- Mosley Paul 1999, Micro-macro linkages in financial markets: the impact of financial liberalization on access to rural credit in four African countries, *Journal of International Development* 11(3): 367-384
- Muhereza, F. 1994. Land Tenure and Peasant Adaptations: Some Reflections on Agricultural Production in Luwero District; In *Uganda Studies in Living Conditions, Popular Movements and Constitutionalism*; Edited by Mahmood Mamdani and Joe Oloka Onyango. Vienna, JEP and Center for Basic Research.
- Nabbumba, R. (1998). Promoting Productivity and Competitiveness of African Agriculture: A Profile of Ugandan Agriculture. Economic Policy Research Centre (EPRC). Kampala, Uganda. National Food Strategy. Kampala, Uganda.
- NEMA (National Environment Management Authority), 1998. *State of the Environment Report for Uganda, 1998*, National environment Management Authority (NEMA), Kampala Uganda:20 – 24.
- Nsabagasani, X. 1997. Land Privatization, Security of Tenure and Agricultural Production: The Ugandan Experience. Institute of Social Studies Working Paper No. 263, Hague, Netherlands.
- Nygaard, D., R. Paarlberg, J. Sanyu-Mpagi, R. Matovu, and S. Babu. 1997. The modernization of agriculture in Uganda: The political challenge of moving from adjustment to investment. International Food Policy Research Institute, Washington, D.C. Mimeo.
- Otsuka, K. 1998. Land tenure and the management of land and trees in Asia and Africa. Paper presented at a policy seminar at the International Food Policy Research Institute, September 3, Washington, D.C.
- Pagiola, S. 1996. Price policy and returns to soil conservation in semi-arid Kenya. *Environmental and Resource Economics* 8:251-271.
- Pender, J. 1999. Rural population growth, agricultural change and natural resource management in developing countries: A review of hypotheses and some evidence from Honduras. Environment and Production Technology Division Discussion Paper No. 48, Washington, DC: International Food Policy Research Institute.
- Pender, J. 1998. Population growth, agricultural intensification, induced innovation and natural resource sustainability: An application of neoclassical growth theory. *Agricultural Economics* 19: 99-112.
- Pender, J.L. 1996. Discount rates and credit markets: theory and evidence from rural India. *Journal of Development Economics*, 50: 257-296.

- Pender, J. and J. Kerr. 1999. The effects of land sales restrictions: Evidence from south India. *Agricultural Economics* 21, 279-294.
- Pender, J. and J. Kerr. 1998. Determinants of farmers' indigenous soil and water conservation investments in India's semi-arid tropics. *Agricultural Economics* 19: 113-125.
- Pender, J.L. and Scherr, S.J. 1998. Organizational development and natural resource management: Evidence from Central Honduras. Mimeo. International Food Policy Research Institute, Washington, D.C.
- Pender, J., S. J. Scherr, and G. Durón. 2000. Pathways of development in the hillsides of Honduras: Causes and implications for agricultural production, poverty, and sustainable resource use. In: D.R. Lee and C. B. Barrett (eds.), *Tradeoffs or Synergies? Agricultural Intensification, Economic Development and the Environment*, Wallingford (U.K.): CAB International.
- Place, F. and Hazell, P. 1993. Productivity Effects of Indigenous Land Tenure Systems in sub-Saharan Africa. *American Journal of Agricultural Economics*. Vol. 75: 10-19
- Platteau, J.P. 1996. The evolutionary theory of land rights as applied to sub-Saharan Africa: A critical assessment. *Development and Change* 27:29-86.
- Reardon, Thomas; Taylor, J. Edward, Agroclimatic Shock, Income Inequality, and Poverty: Evidence from Burkina Faso, *World Development* 24 (5) May 1996, 901-14
- Roth, M., Cochrane, J. and Kisamba-Mugerwa, W. 1994. Tenure security, credit use and farm investment in the Rujumbura Pilot Land Registration Scheme, Uganda. In *Searching for land tenure security*, ed. J. Bruce and Migot-Adholla, S. Kendall/Hunt Publishing, Dubuque, Iowa.
- Rubaihayo, P. 1991. Banana-Based Cropping Systems. A Report on RRA Survey of Banana Production. Research Bulletin No. 2, Banana Programme, Kawanda Agricultural Research Institute (KARI)
- Scherr, S. J., and S. Yadav. 1996 *Land degradation in the developing world: Implications for food, agriculture, and the environment to 2020*. Discussion Paper No. 14. Washington, D.C.: International Food Policy Research Institute.
- Shaxson, F. 1999. New concepts and approaches to land management in the tropics with emphasis on steepplands. FAO Soils Bulletin 75, FAO Soil Resources, Management and Conservation Service, Land and Water Development Division, Rome.
- Singh, I., L. Squire, and J. Strauss, eds. 1986. *Agricultural household models: Extensions, applications and policy*. Washington, D.C.: World Bank and Johns Hopkins University Press.
- Sserunkuuma, D. 1998. Privatization of Property Rights and Rangeland Resource-Use: An Empirical Assessment of Private Farms in Nyabushozi County, Western Uganda. Unpublished Ph.D. Thesis, University of Minnesota.

- _____. 1999. Exploiting Crop-Livestock Synergism: Determinants and Impact on Agricultural Productivity. A Research Paper. Department of Agricultural Economics, Makerere University, Kampala.
- Stoorvogel, J. J., and E. M. A. Smaling. 1990. *Assessment of soil nutrient depletion in sub-Saharan Africa: 1983-2000*. Report 28. Wageningen, The Netherlands: Winand Staring Centre for Integrated Land, Soil and Water Research.
- Swift, M. 1996. Sustainable management of the soil resource: Developing a framework for research and development. Sixteenth Annual Agricultural Symposium, The World Bank. January.
- Templeton, S. and S.J. Scherr. 1996. Population pressure and the microeconomy of land management in hills and mountains of developing countries. Environment and Production Technology Division Discussion Paper. Washington, D.C.: International Food Policy Research Institute. Draft.
- Tenywa, M.M. and R. Lal, 1994. "Impact of Landscape Position on Soil Erodibility," *Eighth ISCO Conference* held on December 4 – 8, 1994, New Delhi India.
- Tenywa, M.M., M.I. Isabirye, R. Lal, A.Lufafa, and P. Achan. 1999. "Cultural Practices and Production Constraints in Smallholder Banana-based Cropping Systems of Uganda's Lake Victoria Basin," *African Crop Science Journal*, 7(4):541-550.
- Tiffen, M., M. Mortimore, and F. Gichuki. 1994. *More people – less erosion: Environmental recovery in Kenya*. London: Wylie and Sons.
- Tukahirwa, J.M. 1996. *Measurement, Prediction and Soil Ecology of Accelerated Soil Erosion in Kabale District*, Ph.D. Unpublished Thesis, Makerere University
- Tumuhairwe, J. K., Nsubuga, E. N. B. and Kahembwe, F. 1998. Acceptance and Impact of Soil and Biodiversity Conservation Approaches in Southwestern Uganda. EAPLEC Project, Makerere University
- Turner, B.L., G. Hyden, and R. Kates. 1993. Population growth and agricultural change in Africa. Gainesville, FL: University Press of Florida. Vol. 8:315-332.
- United States Library of Congress. 1992. Uganda: A country study. Washington, D.C., Library of Congress, Federal Research Division
- Walaga, C.C., B.N. Egulu, A. de Jager, M.S. Van Wijk, 1999. "Nutrient Balances and Economic Performance of Smallholder Farming Systems in Uganda: New Insights, New Challenges," In: Zake, J.Y.K., J.K. Tumuhairwe, C. Nkwiine, and S. Sessanga. *Soil Science, a Key to Sustainable Land Use*, Proceedings of the 17th Soil Science Society of

- East Africa (SSSEA) Conference held in Kampala Uganda, September 6 – 10, 1999. p. 31.
- Wood, S., K. Sebastian, F. Nachtergaele, D. Nielsen, and A. Dai. 1999. Spatial aspects of the design and targeting of agricultural development strategies. Environment and Production Technology Division Discussion Paper 44, International Food Policy Research Institute, Washington, D.C.
- Wortmann, C.S. and C.K. Kaizzi. 1998. Nutrient balances and expected effects of alternative practices in farming systems of Uganda. *Agriculture, Ecosystems and Environment* 71(1-3): 115-130.
- Yanggen, D., Kelly, V., Reardon, T., and Naseem, A. 1998. Incentives for fertilizer use in Sub-Saharan Africa: A Review of empirical evidence on fertilizer response and profitability, MSU International Development Working Paper # 70, East Lansing, MI.
- Zake, J. Y. K. 1992. Issues arising from the of soil conservation: The Ugandan example. *In Soil conservation for survival*, ed. K. Tato and H. Hurni. Soil and Water Management Conservation Society.
- Zake, J.Y.K. 2000. Personal Communication.
- Zake, J.Y.K. and M. Magunda, 1999. "Soil Conservation in the Highlands of Uganda," In: McCulloch, A.K., S. Babu, and P. Hazell (eds). *Strategies for Poverty Alleviation and Sustainable Resource Management in the Fragile Lands of Sub-Saharan Africa*, Proceedings of the International Conference held from 25 – 29 May, 1998 in Entebbe, Uganda. International Food Policy Research Institute (IFPRI) and National Agricultural Research Organization (NARO) and European Commission (EC). Pp 288-291
- Zake, J.Y.K., M.K. Magunda, and C. Nkwiine. 1997. "Integrated Soil Management for Sustainable Agriculture and Food Security: The Uganda Case," Paper Presented to *Workshop on Integrated Soil Management for Sustainable Agriculture and Food Security in Southern and East Africa*, Harare Zimbabwe, December 8 – 12, 1997 (Unpublished).

Table 1. Classification of Productive Activities/Livelihood Strategies

Type of occupation	Orientation	Crop period	Marketability	Examples of products/activities
Crop	Subsistence	Perennial	NA	Matooke
		Annual	NA	Sorghum Millet Cassava Sweet potato
	Cash	Perennial	Storable	Coffee
			Perishable	Matooke Fruits Sugarcane
		Annual	Storable	Cotton Maize Beans
			Perishable	Vegetables
Livestock	Subsistence	NA	NA	Oxen Cows Small stock
	Cash		Transportable	Beef cattle, sheep, goats
			More costly to transport (relative to value)	Poultry, pigs
			Perishable	Dairy production Fish farming
Forestry	Subsistence	Perennial	NA	Collection of forest products for home use
	Cash		Transportable	High value forest products (e.g., hardwood for furniture)
			Less transportable	Low value forest products (e.g., fuelwood)
Rural non-farm industry	Linked to ag. production	NA	NA	Coffee processing Cotton milling Sugarcane mills Grain milling Cassava milling Input and output mktg.
	Not linked to ag. production			Mining Construction Services Crafts
Urban employment	Linked or not linked to ag.			Many types

Table 2. Hypotheses about Suitable Locations of Potential Development Pathways

Development Pathway	Agricultural Potential	Market Access	Population Density
Expand subsistence perennial food production	Bimodal medium	Low	Low
Expand subsistence annual food production	Bimodal medium Unimodal medium	Low	Low
Expand storable perennial cash crop production	Bimodal medium	Low or High	Low
Expand perishable perennial cash crop production	Bimodal medium	High	Low
Expand storable annual cash crops	Bimodal medium Unimodal medium	Low or High	Low
Expand perishable annual cash crops	Bimodal medium Unimodal medium	High	Low
Intensify subsistence perennial food production	Bimodal medium Highlands	Low	High
Intensify subsistence annual-livestock food production	Bimodal medium Highlands	Low	High
Intensify storable perennial cash crop production	Bimodal medium Highlands	Low	High
Intensify perishable perennial cash crop production	Bimodal high Bimodal medium Highlands	High	High
Intensify storable annual cash crops	Bimodal medium Highlands	Low	High
Intensify perishable annual cash crops	Bimodal high Bimodal medium Unimodal medium Highlands	High	High
Increase extensive livestock production (cattle, small ruminants)	Bimodal medium Bimodal low Unimodal medium	Low	Low

Increase intensive dairy production	Bimodal high Bimodal medium Unimodal medium Highlands	High	High
Intensify other livestock production (pigs, poultry, rabbits, fish farming)	All	High	High
Production of high value forest products	Bimodal medium Unimodal medium	Low or High	Low
Production of low value forest products	Bimodal medium Unimodal medium	High	Low
Rural industry linked to agriculture	All	High	High
Rural industry not linked to agriculture	Depends on other factors	High	High
Urban employment	Bimodal high (close to Kampala)	High	High

Table 3. Development Domains and Potential Development Pathways in Uganda

Agricultural Potential	Market Access	Population Density	
		High	Low
Bimodal high potential	High	Lake Victoria region - Intensify perennial cash crops - Intensify perishable annual cash crops - Increase intensive dairy production - Intensify other livestock production - Rural industry linked to agriculture - Urban employment	(not represented)
	Low	(not represented)	(not represented)
Bimodal medium potential	High	North of Lake Victoria region, Parts of W. Uganda - Intensify perennial cash crops - Intensify annual cash crops - Increase intensive dairy production - Intensify other livestock production - Fish farming - Rural industry linked to agriculture	Parts of Luwero, Nakasongola - Expand perennial cash crops - Expand annual cash crops - Production of forest products
	Low	Some parts of W. Uganda - Intensify subsistence perennial crops - Intensify subsistence mixed annual-livestock - Intensify storable perennial cash crops - Intensify storable annual cash crops	Most of Central Uganda - Expand subsistence perennial food crops - Expand subsistence annual food crops - Expand storable perennial cash crops - Expand storable annual cash crops - Increase extensive livestock production - Production of high value forest products
Bimodal low potential	High	Parts of S.W. Cattle Corridor - Increase intensive dairy production - Intensify other livestock production - Rural industry linked to agriculture	Parts of S.W. Cattle Corridor - Increase extensive livestock production - Rural industry linked to agriculture
	Low	(not represented)	Most of S.W. Cattle Corridor - Increase extensive livestock production
Southwest highlands	High	Most of S.W. Highlands - Intensify perennial cash crop production - Intensify annual cash crops - Increase intensive dairy production - Intensify other livestock production - Rural industry linked to agriculture	(not represented)
	Low	Parts of S.W. Highlands - Intensify subsistence perennial crops - Intensify subsistence mixed annual-livestock - Intensify storable perennial cash crops - Intensify storable annual cash crops	(not represented)
Unimodal medium potential for annuals	High	W. Kumi, Parts of Soroti, Lira, Apac - Intensify annual cash crops - Increase intensive dairy production - Intensify other livestock production - Rural industry linked to agriculture	Parts of Soroti, Lira, Apac - Expand annual cash crops - Production of forest products - Rural industry linked to agriculture
	Low	(not represented)	Much of North and Northeast Uganda - Expand subsistence annual food production - Expand storable annual cash crops - Increase extensive livestock production - Production of high value forest products

Agricultural Potential	Market Access	Population Density	
		High	Low
Eastern highlands	High	Mbale - Intensify perennial cash crops - Intensify annual cash crops - Increase intensive dairy production - Intensify other livestock production - Rural industry linked to agriculture	(not represented)
	Low	Kapchorwa - Intensify subsistence perennial crops - Intensify subsistence mixed annual-livestock - Intensify storable perennial cash crops - Intensify storable annual cash crops	(not represented)