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LAND MANAGEMENT PROBLEMS AND POTENTIALS IN THE LAKESHORE INTENSIVE BANANA-COFFEE FARMING SYSTEM

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A Paper Prepared for the Regional Conference on Policies for Sustainable Land Management in the East African Highlands held from April 24-26, 2000 at the United Nations Economic Commission for Africa (UNECA) Conference Center, Addis Ababa, Ethiopia.

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I. Introduction

The intensive banana-coffee farming system is found in the Lake Victoria crescent in the districts of Mukono, Mpigi, Wakiso, South Luwero, Mubende, Kalangala, Rakai, Masaka, Iganga and Kamuli. The system supports seven million people, receives sufficient rainfall to support perennial crop production (ranging between over 1000 and 1500 mm per annum for 10 to 12 months of the year) and has the most favorable access to infrastructure and markets compared to other regions in Uganda (Deininger and Okidi, 1999). Because of its high population density, market access and medium to high agricultural potential, this region has the highest economic potential among all rural areas in Uganda (Bashaasha, 2001; Sserunkuuma et al., 2001a).

These three factors (market access, population density and agricultural potential) affect the costs, risks and constraints of producing and marketing different agricultural commodities in the region, as well as the opportunities and returns to alternative activities such as non-farm employment. As a result, some pathways of development[1] have a comparative advantage (highly profitable) in the lakeshore region and others don't.

[1] A development pathway is defined as a common pattern of change in livelihood strategies, such as expansion of intensive dairy production or intensifying the production of high value perishable annual cash crops such as vegetables (Sserunkuuma et al. 2001a). This concept is similar to the concepts of farming systems and livelihood strategies, but is more general than farming systems since it incorporates non-farm as well as farm activities (as does the concept of livelihood strategies), and is dynamic since it refers to changes and not merely livelihood strategies pursued at a particular point in time.

Several pathways of development have been identified as having potential in this region, with the most profitable ones involving intensive production of livestock products, high value perishable annual crops such as vegetables, and high value perennial crops such as coffee and matooke, or development of non-farm activities (Pender et al, 2001). The intensification of low value storable annuals such as maize and beans also has potential in this area.

Different development pathways have different impacts on land management, productivity, and other resource and welfare outcomes. For example, in the lakeshore region, banana (matooke) yields have been declining for the past few decades, largely due to declining soil fertility[2] and increasing pest and disease pressure (Gold, et al., 1999), although off-farm opportunities and rising labor costs may also be important causal factors (Sserunkuuma et al., 2001a). It is estimated that matooke production in central Uganda fell by 14% of total food production and five percent of total cash crop production between 1970s and 1990s (ibid.). Coffee production is also reported to be declining due to the growing problem of coffee wilt disease (CWD), and it is estimated that approximately 8.4 tons of clean coffee worth 13.44 billion Ushs. is lost annually due to CWD (UCTF, 1999). These perennials (banana and coffee) are reportedly being replaced by annual crops (such as maize and beans), which leave the soil exposed to erosive forces and have caused a considerable increase in soil erosion, estimated to be above the tolerable rate of five tons per hectare per year (Lufafa et al., 2000). Because of

[2] Many factors are believed to have caused this decline in soil fertility, the most important ones being related to human activity 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

soil erosion and other avenues of soil nutrient loss, an estimated 80-100 kg of NPK is lost per hectare per year in the lakeshore region and other parts of central Uganda (IFDC, 1999).

Proceeding along the above-described annuals expansion pathway of development without investing in land improvement would result in a downward spiral of decreasing soil fertility and crop yields in the region, with serious implications for food security and poverty. On the other hand, adopting the intensive pathway (increasing investment in soil and water conservation and use of external inputs to replenish soil nutrients) could improve land conditions, current and future agricultural productivity and welfare outcomes. A survey of 107 LC1s and villages in different development domains in Uganda found that banana-coffee intensification is associated with more favorable resource outcomes than cereals expansion (Pender et al., 2001).

In this paper, the term intensification is used in a narrow sense to refer to the use of external inputs such as improved seed and animal breeds; and the use of inorganic fertilizer or manure to maintain or enhance soil fertility. Other types of intensification, such as intensive use of labor in soil and water conservation are not considered in this paper. The paper addresses two questions. The first question is whether the development pathways used for crops and livestock production in the lakeshore region are intensive or not and what the implications are for land management. The second question is what influences (constrains or enables) farmers to intensify. The remaining part of this paper is

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conservation, deterioration of erosion control structures, deforestation, overgrazing, etc. (Sserunkuuma et al. 2001a).

divided into five sections. Section II presents the research methods used to address the above questions. Section III reviews the changes in livelihood activities in the study region between 1990 and 2000, the reported reasons for these changes, and the land management problems associated with these livelihood activities. Section IV examines the level and potential of intensification in mitigating land management problems associated with crop and livestock production livelihood activities. Section V identifies the determinants of intensification at the household level, and section VI concludes the paper and discusses a few policy implications.

II. Methodology

The data used in this study is part of a bigger data set obtained through a survey of 451 households sampled from 107 communities in Central, Eastern, Western and Northern Uganda. Out of the 107 communities, 100 were selected by stratified random sampling[3], and the rest (7 communities) were selected from areas where the African Highlands Initiative (AHI) and International Tropical Research Institute (CIAT) were operating to capture the impact of program intervention on livelihood activities and outcomes. From each of these communities, four households were randomly selected for household and plot-level surveys to gather information on nutrient flows and household socio-economic characteristics. These surveys began in November 2000 and ended in July 2001. Out of the total sample of 451 households, 137 (30%) were from 8 of the 10 districts that make up the intensive lakeshore banana-coffee farming system (Mukono, Mpigi, South Luwero, Mubende, Rakai, Masaka, Iganga and Kamuli). Two districts (Kalangala and

[3] See Pender et al., 2001 for details of sampling method used

Wakiso) were left out because Wakiso was part of Mpigi district when the surveys were conducted and Kalangala lies outside the study area.

This paper focuses on the 137 households from the intensive lakeshore banana-coffee farming system and analyses changes in livelihood strategies during the past decade, their causes and associated land management problems as well as the constraints and opportunities for solving these problems through intensified agricultural production. The analysis uses univariate and multivariate methods. The univariate analysis is based on descriptive statistics of factors believed to influence the use of external inputs in agricultural production (intensification). The multivariate analysis uses econometric methods to simultaneously examine the relative importance of several factors explaining use or non-use of external inputs in agricultural production. Two econometric models are used in the analysis, namely, the Probit and Tobit models.

The Tobit model is more appropriate in analysing adoption because it addresses both the questions of whether or not to adopt; and if yes, how much. On the other hand, the Probit model only stops at determining the probability of adoption and doesn't address the question of intensity of adoption. Using the Tobit model, however, requires having reliable data on the level of use (such as area planted or quantity of input applied) of the technology by the adopters. Where such information is lacking, it is better to use the Probit model, in which the dependent variable is assigned a value of one for adopters and zero for non-adopters. For the Tobit model, the dependent variable for non-adopters is also assigned a value of zero but becomes a continuous outcome for adopters, measured

in terms of quantity of external inputs used. For specification of the Probit and Tobit models, refer to Maddala (1985 and 1989). Therefore, both models have been used in this study and the choice of which model to use was based on reliability (or lack of it) of quantity data for external inputs used.

III. Changes in Livelihood Activities and Land Management

Survey data from 12 communities in the lakeshore region shows that the production of matoke and coffee has for long been and remains an important livelihood activity despite the declining yields for these crops, while the production of maize and beans and livestock keeping all increased in importance as livelihood activities during the past decade (Sserunkuuma et al. 2001b). Off-farm employment was found to be limited, and this is no surprise given the high level of unemployment countrywide and the low level of investment in agricultural-related industries in rural areas, although trading and brick making gained importance in a few communities. The production of horticultural crops (such as vegetables) grew slightly in importance where there is good access to urban markets, but was not listed among the three most important activities pursued by men and women in the lakeshore region (ibid).

Most of these findings are corroborated by household data of 137 households surveyed from the same communities. The production and sale of crops was the most common primary and secondary income source in 2000, mentioned by 67% (primary) and 34% (secondary) of households, and the number of households depending on it as their primary source of income increased by over 16 percentage points between 1990 and 2000

(see Table 1). During the same period, the production and sale of livestock and livestock products also grew in importance (though slightly) as a primary and secondary income source. The major livestock and crop enterprises that grew in importance during this period include cattle, pigs, poultry (chicken), banana, coffee, maize and beans. The proportion of households engaged in the production of all the above increased between 1990 and 2000 (see Table 2).

Although non-farm activities in the form of salary/wage employment and non-agricultural family business such as transportation, operating a retail shop/kiosk, etc., were an important income source, their importance decreased as a primary income source between 1990 and 2000 but increased as a secondary income source during the same period. They changed from being the second to the third most common primary income source, and from being the third to the second most common secondary income source. However, the proportion of households depending on trading in agricultural outputs and inputs as a primary and secondary income source increased during the 10-year period, making it the second most common primary income source (replacing salary/wage employment/non-agricultural family business) and third most common secondary income source (See Table 1). This could be a result of the liberalization of trade in agricultural inputs and outputs, which increased the number of traders dealing in agricultural products and stimulated production for the market (increased commercialization of agriculture).

These findings suggest that an increasing number of households in the lakeshore region are scaling down on non-farm activities and turning to agricultural production and trade

as a primary source of income, which underscores the importance of the Plan for Modernization of Agriculture (PMA) as a linchpin of the government strategy to alleviate poverty. Because the proportion of Uganda's labor force employed in agriculture is large (over 80%) and growing, transforming the agricultural sector presents a great opportunity for poverty reduction in Uganda.

Reasons for change in primary and secondary household livelihood activities (income sources)

The changes in importance of livelihood activities discussed above were attributed to several factors, which have been grouped into four categories following the Sustainable Livelihoods (SL) framework (Farrington et al, 1999). The four categories include livelihood assets (human, natural, physical, social and financial), transforming structures and processes (such as government policies and institutions), the vulnerability context defined by shocks, trends and seasonality, and others.[4]

Table 3 shows that vulnerability (shocks, trends and seasonality) was most important in influencing changes in livelihood activities (income sources) pursued by households between 1990 and 2000, followed by capital or asset factors. Furthermore, it is mostly negative vulnerability situations (such as reduction in soil fertility and commodity prices, increased pest and disease pressure, failing health or old age, reduced employment

[4] The vulnerability context is about shocks (such as droughts, pest and disease epidemics, wars, rapid changes in terms of trade and exchange rates, etc), overall trends (in population and natural resource stocks and conditions such as soil fertility) and seasonality or changes in prices, production, health and employment opportunities that reinforce or undermine a given livelihood activity depending on whether they are negative or positive. Livelihood assets (human, natural, physical, social and financial capital) enable (or constrain) households to pursue given livelihood activities. Transforming structures and processes (such as government policies related to infrastructure, taxation, etc) may constrain (enable) households from pursuing given livelihood activities. The category "Other" includes all reasons that

opportunities) rather than positive ones (such as increase in commodity prices, or emergency of new markets); and lack (or reduction) of capital rather than abundance (or increase) of capital that drove the changes in livelihood activities pursued by the surveyed households between 1990 and 2000. This suggests that the surveyed households changed livelihood activities not because of emergence of new and better paying opportunities compared to what they were doing before, but mainly as a coping strategy to unfavorable changes threatening their incomes and food security status. Thus, the observed changes in livelihood activities were more of a response to an unfavorable trend in soil fertility or pest and disease shock, for example, than being the cause of this trend or shock. It may be necessary, therefore, to support rural households to cope with or recover from these shocks or trends so as to maintain or enhance their capabilities to attain desired livelihood outcomes (improved income, food security and natural resource conditions) on a sustainable basis.

Land Management Problems and Opportunities Associated with Emerging Livelihood Activities

Besides factors that naturally affect land conditions and productivity, such as soil type (erodibility and vulnerability), relief and climate, the development pathway pursued in a given location may have a big impact on land management and productivity. As mentioned earlier, the production of perennials (coffee and banana), storable annuals (maize and beans) and livestock is increasing in the lakeshore region. Trading in these and other agricultural outputs is also increasing, which suggests increased commercialization. Under such circumstances, cash incomes are expected to be

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couldn't be fitted in the above categories, for example, the respondent was still under parents'/husbands' care or they changed location and, thus, livelihood activity, etc.).

increasing, facilitating farmers' ability to purchase and use inputs such as fertilizers, improved seed and pesticides, thereby intensifying production of the above-listed crops (Pender et al, 2001). Where intensive livestock production is occurring, such as dairy development, increased use of stall feeding and recycling of animal wastes to the soil through manuring and composting is likely.

If adopted, such land management practices can bring about improvements in soil fertility and agricultural productivity, though this is not assured given increasing export of nutrients via commercialization, which may not be adequately replenished by manure, compost or fertilizer application (ibid.). The proportion of total production sold for four crops (coffee, bananas, maize and beans) and their contribution to household crop income is presented in Table 2. The results show that of the three food crops (maize, beans and bananas), maize is most important as a commercial crop, that is, it has the highest proportion of total output sold (29.2%) and its contribution to household crop income (21.9%) is equal to that of coffee and is higher than both bananas and beans. This has serious implications for land management. As already mentioned, maize production exposes land to forces of erosion because it doesn't provide a good soil cover. In addition, it is associated with export of nutrients from the farm via commercialization, which leads to nutrient mining if nutrients are not replaced by use of external inputs. Thus, the nutrient loss associated with maize production and export from the farm implies increased land degradation unless improved land management practices (such as use of external inputs). The next section examines the level of use of external inputs (intensification) in agricultural production.

IV. The Level of Intensification in Selected Crops and Livestock Production

For purposes of this study, the level of intensification in crop and livestock production is measured by the proportion of households using improved technologies (improved seed and breed of livestock or inorganic and organic fertilizer) as well as the quantity of these inputs used and proportion of improved breed livestock kept by the surveyed households.

Livestock

Out of the 137 households studied, the number of households that kept improved breed cattle (crosses and pure breeds) increased from 12(8.8%) in December 1990 to 17(12.4%) in December 2000 (See Table 4). The average percentage of improved breed cattle held by the surveyed households also increased from 5% in 1990 to 9.5% in 2000, implying increased (albeit slight) intensification among cattle farmers. The proportion of households that kept improved breeds of pigs and chicken both in 1990 and 2000 was very low, ranging between 0 and 2.9% (See Table 4) and could not be used to compute representative proportions of improved breed livestock kept by the 137 households surveyed. Although the intensification of livestock production has high potential in the lakeshore region, the study results indicate that it is still at a very low level.

Maize

72.18% and 69.9% of the surveyed households produced maize in the first and second cropping seasons respectively, in the year 2000 (See Table 5)[5]. A lower proportion of

[5] Note that the percentage of households growing maize in 2000 reported in Table 5 (72.18% and 69.9%) is lower than the percentage reported in Table 2 (91.11%). The reason is that Table 2 was constructed using household-level data while Table 5 was constructed using plot-level data gathered only on plots operated

households 44.36% (for the first season) and 39.85% (for the second season) grew improved varieties of maize and the average quantity of improved maize seed planted was 7.93 kgs for the two seasons combined (See Table 6). This shows a high level of adoption for improved maize varieties. However, the proportion of households using inorganic fertilizer, manure and compost on maize is very low (ranging between 0 and 3.1%), and so is the average quantity of these inputs used (See Tables 5 and 6). The implication is that many farmers are adopting high-yielding maize varieties that mine more nutrients (than low yielding varieties) from the soil without using external inputs to replenish the lost nutrients. It is virtually certain that this piecemeal adoption of improved seed-fertilizer technology packages will eventually cause nutrient depletion, unless farmers are encouraged or supported to begin replenishing the lost nutrients.

Beans

The case for beans is quite similar to that of maize. 60.9% and 53.4% of the surveyed households produced beans in the first and second cropping seasons respectively, in the year 2000, and about half of these (28.57% in the first season and 25.56% in the second season) used improved beans varieties, at an average rate of 6.59 kgs per household for the two seasons combined (See Tables 5 and 6). No household used inorganic fertilizers or compost on beans, while only two households (1.55%) used manure on beans in the second season of 2000. Again as with maize, very little or nothing is being done to replenish soil nutrients lost through harvesting of crops.

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by the household within the LC1 where the household's home is located. The figures for Table 2 are bigger

Bananas (Matooke)

Intensification with respect to banana production only refers to the use of fertilizer (inorganic or organic) or compost since there were no improved varieties to talk about. Table 5 shows that 67.67% of the households grew cooking bananas (matooke) in 2000, and about one fourth of these (18.94% in first season and 15.5% in second season) applied manure, and a lower proportion applied compost (nearly 7%). On average, 417 kgs of manure and 50.71 kgs of compost per household were applied to bananas in 2000 (See Table 6). No household used inorganic fertilizers on bananas.

Coffee

Although clonal coffee can be regarded as an improved variety of robusta coffee (it is higher-yielding and faster maturing than the traditional type), the data collected does not make a distinction between clonal and traditional robusta. Thus, the indicator of intensification for coffee used in this paper is similar to that of bananas, which is use of fertilizer (inorganic or organic) or compost. 57.14% of the surveyed households grew robusta coffee in 2000. Only two (1.52%) of these households applied inorganic fertilizers one household applied compost to coffee fields in 2000. A bigger percentage of households (9.85% in first season and 9.3% in second season) applied manure to coffee fields (See Table 5). On average, 152 kgs of manure per household were applied to coffee fields in the year 2000 (See Table 6).

Overall, the current level of intensification in crop and livestock production in the lakeshore region seems to be insufficient to bring about improvements in soil fertility and

because they include activities undertaken on plots outside the LC1

agricultural productivity needed to reduce poverty and food insecurity in the region. Much as a significant proportion of farmers are using improved varieties of maize and beans, this alone is not enough to sufficiently enhance yields. Instead, it increases the rate of soil nutrient mining and negatively affects current and future crop yields. It is imperative that the use of external inputs is increased to replenish lost nutrients. The use of inorganic fertilizers is almost non-existent but a few households are using manure on bananas and coffee. The use of improved varieties of livestock is also low. These results are consistent with the findings of Pender et al. (2001) from a community-level survey of 107 LC1s and villages that the banana-coffee expansion pathway was most strongly associated with adoption of soil and water conservation practices, while the cereals expansion pathway was not associated with adoption of soil and water conservation practices. As a result, several resource conditions are worsening more in the cereals expansion pathway than in other pathways, while several are improving more in the banana-coffee expansion pathway than in others (ibid.)

Despite the fact that a growing number of rural households in the lakeshore region are embracing agricultural production as their primary income source, the existing opportunities for increasing their incomes through greater intensification are not being exploited. This suggests that there are constraints hindering farmers from intensifying, which must be overcome to improve agricultural productivity, land resource conditions and welfare outcomes. The next section takes a look at what some of these constraints might be.

V. Determinants of Intensification in Crop and Livestock Production

The decision on whether to adopt improved production technologies (intensify) or not hinges a lot on farmers' ability and willingness to adopt (Nowak, 1992). The reasons for inability to adopt include lack of (or insufficient) information, high cost of obtaining the information, too expensive or costly technology, excessive labor required, limited, inaccessible or unavailable support systems such as credit and extension, etc. The reasons for little or no willingness to adopt include inconsistent or conflicting information, technology not fitting well in farmers' production goals, ignorance of the technology, high risk associated with the technology, etc (ibid).

Lack of credit, for example, makes poor farmers unable to use purchased inputs needed for sustainable agricultural development (Larson and Frisvold, 1996) even if they are aware that the returns from doing so are high. It also 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). Where credit services are unavailable, farmers must rely on their own savings as a source of investment capital. Also income from off-farm sources can serve to generate funds for agricultural investments where credit availability is low (Reardon et. al., 1996). However, off-farm employment opportunities may compete for labor with agricultural activities, and thus tend to reduce the adoption of labor-intensive technologies.

Lack of a well-developed labor market makes labor scarce and costly in some places, which may undermine farmers' ability to invest in soil fertility conservation and other

practices that are labor intensive. Imperfections in labor markets mean that household endowment of labor have a direct effect on the level of agricultural production and use of other inputs (Deininger and Okidi, 1999). That is, imperfect labor markets force farm households to rely entirely on family labor to carry out all farm activities including soil conservation, thus, limited availability of family labor could undermine farmers' ability to intensify.

High fertilizer prices, relatively low and unstable agricultural output prices and the low degree of commercialization of agriculture may limit farmers' demand for purchased inputs and may, thus, be a significant contributing factor to the low level of intensification. Agricultural training and extension have a significant role in promoting intensification, because they increase farmers' receptiveness and ability to use new technologies. Without such training, farmers may for example not be aware of land degradation problems facing them, or they may attribute such problems to causes beyond their control, thereby reducing their efforts to address such problems (Ervin and Ervin, 1982). Programs and organizations that give technical assistance or training/education in agriculture and environmental conservation are likely to have a direct effect on the decision to intensify, while those focusing on marketing and credit service provision, for example, may have strong indirect effects on this decision. For example, provision of credit to organization members may increase their ability to purchase and use inorganic fertilizer or pay for hired labor needed for labor-intensive practices.

Land tenure may influence the decision to intensify or not. The standard hypothesis about land tenure and land management is that non-exclusive, insecure and non-transferable land rights will lead to under-investment in land improvement (and promote land degradation), because recouping benefits from doing so is not guaranteed. 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. Most of the above-listed constraints to intensification are worsened by poverty or lack of capital, be it natural, social, physical or human (education, experience, etc.). Educated and older farmers (more experienced) are likely to be better equipped to process and use information that comes with new technologies. The gender of the household head may also indirectly affect intensification; through its effect on access to production resources especially land. Most women do not own the land they cultivate. Besides household-level factors, farmers' decision to intensify or not may be influenced by village or community-level factors such as market access, population density and agricultural potential. For instance, in areas with high population density, individual land holdings may become too small to allow expansion such that the only option that farmers are left with is to intensify. The summary statistics of many of the above-mentioned factors affecting the ability or willingness of the surveyed households to intensify are presented and discussed below.

Access to Credit

The percentage of the households that applied for credit from formal sources increased from 2.19 in 1990 to 18.98 in 2000 (See Table 7). All those who applied for formal credit

in 1990 received it, while 92.3% of the applicants received credit from formal sources in 2000. The percentage of households that applied for credit from informal sources increased from 33.58 in 1990 to 64.96 in 2000. 95.6% of those who applied for informal credit did receive it in 1990 compared to 97.8% in 2000. The average amount of the credit acquired in cash in 2000 was 124,658 UShs and that for in-kind credit was 4,040 UShs, mostly in form of household consumable goods like sugar, paraffin and salt borrowed from traders.

Although there has been an increase in the number of households accessing credit from formal sources, many households are reluctant to seek such credit and the majority rely on informal credit sources like friends and relatives. The reasons for shunning formal credit sources are varied but they include fear of failing to pay back on time and losing collateral, high interest rates, short payback period and other stringent loan requirements.

The loan amount acquired (124,658 UShs in cash and 4,040 UShs in-kind) suggests that people mostly acquire small loans not for purposes of investing but rather to meet consumption and emergency cash needs. Besides the low density of credit services in rural areas, it is likely that even the few that are there are not affecting intensification either because farmers shun them or when they borrow, they do so in small amounts to meet consumption and emergency cash needs but not for investing in agriculture. It is probably because such small loans are rarely given out by formal credit sources that most people borrow from informal sources.

Savings

The proportion of households that saved (in form of agricultural produce, assets such as land and livestock, cash at home or with banks, etc) increased from 83.70 in 1990 to 97.78 in 2000 (See Table 8). This suggests an improvement in the culture of saving. However, there has been a substantial reduction in the use of banks and an increase in keeping money at home and in form of livestock as a primary form of saving. Also, a significant proportion of households (11.85%) saved by storing crop produce either for future sale/or consumption. While the low interest offered on savings by banks and the recent wave of bank closures are possible reasons for the reduction in use of banks as a way of storing money, the purpose of saving also influences the method used to save, i.e., the method or form of saving is indicative of the purpose of saving. Keeping money at home implies that it is most likely for consumption in the immediate future rather than for investment. Therefore, while the saving culture seems to have improved during the past decade, it is unlikely that this has had an affect on intensification, judging from the dominant methods of saving used.

Membership to Organizations

As mentioned earlier, programs and organizations that give technical assistance or training/education in agriculture and environmental conservation are likely to directly affect the decision to intensify, and others like those focusing on credit provision may have strong indirect influence on this decision. Table 9 shows that the majority of households (31.4%) had their members participating in funeral organizations, followed by credit organizations in which 27% of the households' members participated. Only

4.4% of the households had their members involved in natural resource management and marketing organizations, while of 13.1% and 10.9% percent of the households participated in informal education or training and primary agricultural production organizations, respectively.

The percentage of households with their members participating in natural resource management organizations is very small and this could be one of the reasons for low levels of intensification. However, through credit provision, informal education or training and technical assistance in agricultural production, programs and organizations are likely affecting the level of intensification in the lakeshore region.

Agricultural Training and Extension

Of the 137 households surveyed in the lakeshore region, 31 (22.6%) received training in soil and water conservation and 11 households (8.0%) received extension advice on the same subject (See Table 10). A much bigger number of households (91) received training in crop agronomy and 24 households (17.5%) were visited by extension agents on the same subject. 23 households (16.8%) received training in plant protection and a much smaller number of households (8) received extension advice on this subject. Only 9 households (5.8%) received training in livestock management and agricultural produce marketing.

This shows that agricultural training and extension programs put more emphasis on crop agronomy (time of planting, spacing, weed control, seed rates, etc.) than soil and water

conservation and plant protection, yet declining soil fertility and increased pest and disease pressure are the two most common reasons cited by farmers for the decline in crop yields over the past decade (Sserunkuuma et al, 2001a). The importance attached to these two problems as a cause of declining agricultural productivity suggests that agricultural training and extension programs need to focus more on soil and water conservation and pest and disease management as well to increase the level of intensification.

Land Tenure

Of the 137 households studied, 59 (43.1%) hold at least one parcel of land under the mailo tenure, and about half of all the parcels owned (48.48%) are under the mailo tenure system (See Table 11). Nearly the same number of households hold at least one parcel under free hold tenure (N=39) and customary tenure (N=38). Only 15 households (0.9) hold some of their land as leasehold. Despite the fact that the most dominant tenure systems (mailo and freehold) entitle those owning land under these systems to a land title, only 14 households (10.2%) have in their possession land titles on at least one of the parcels they own. This suggests that either people feel their rights to the land are secure enough without titles that they see no need of spending money to have their land registered or because they don't intend to mortgage their land anytime soon, they attach little value to holding titles. With the exception of mailo land that may have been rendered less secure recently because of recognition of the rights of occupants by the Land Act of 1998, all the other categories of land tenure seem secure enough not to discourage intensification efforts. Also because there is limited use of land as collateral to

acquire loans (either because formal credit sources are limited or people shun them), land titling may also have no effect on the level of intensification

Other Socio-Economic Characteristics of the Surveyed Households (Tables 12 to 15)

90.37% of the households were male-headed and the average age of the household head was 44.75 years. The average family size was 10.88 persons per household, out of whom 59.71% were above 12 years old, capable of providing family labor needed for agriculture. The average person-hours of labor hired (imported) in 2000 for undertaking agricultural activities was 687.158, and the average hired labor expense was 144,785 Ushs. The surveyed households also exported labor for agricultural activities in 2000 to the tune of 133.382 persons-hours, and the average household earnings from exported agricultural labor was 85,409.59 Ushs. On average, 46.67% of all household members acquired some but did not complete education, while 18.96% did complete primary education. 16.20% acquired but didn't complete secondary education, 6.84% completed ordinary level and 1.64% completed Advanced level. 0.18 of the family members never went to school. On average, each household has a total land area of divided between 2.22 parcels.

Total land endowment averaged 8 acres, split into 2 parcels on average of 4 acres each. The average number of cattle owned increased from 2 in 1990 to 2.8 in 2000, and the average total value of cattle increased from 313,602 Ushs to 493,209 Ushs during the same period. The average number of pigs kept decreased from 1.549 to 0.926 per household, while that for chicken increased from 11.8 to 13 between 1990 and 2000. The

total value of household equipment and durables increased from 111,240.9 Ushs to 155,443.7 Ushs during this period. And finally, the average total value of agricultural produce disposed in 2000 was 541,268 Ushs, while household income from non-agricultural sources such as petty trade, remittances, sale of charcoal, handicraft and beverages average 470,144.8 Ushs in 2000.

Econometric Results

Table 16 summarizes Probit model results for important factors affecting the use of manure on bananas. These factors include market access, proportion of household members greater than 12 years of age, total land area (farm size), ownership of pigs and cattle and hours of contact with extension agents.

As expected, contact with extension agents, market access and livestock ownership (pigs and cattle) significantly enhances the application of manure on bananas, while farm size (total land endowment of the household) negatively affects it since larger farms can increase or maintain production using extensive methods which may not be possible for smaller farms. Farmers with better access to markets receive better prices than those with poor market access, which induces them to use yield-enhancing inputs (such as manure) to increase yields and take advantage of the better prices. The fact that livestock ownership enhances manure use shows that farmers mostly rely on own supply of manure because its low value to volume ratio makes it less tradable.

Surprisingly, however, the proportion of household members over 12 years of age (a proxy for family labor usable for agricultural production) negatively affects manure use on bananas. This may be the result of increased school attendance by children of primary and secondary school age because of introduction of UPE and increased availability of secondary schools (Pender et al 2001), which reduces family labor available for agricultural activities. Therefore, while increased investments in education may be a positive development, there are trade-offs in terms of reduced availability of family labor to undertake labor-intensive land improvement investments. It may also be a result of the fact that given a fixed size of land to farm, the more members in the productive age category there are in a household, the greater the tendency for many of them to leave farming for non-agricultural activities as the from returns using their labor on this fixed land reduce, thereby creating a shortage of labor to undertake land improvement investments.

For coffee, the important factors affecting manure use include population density, age of household head and ownership of cattle (see Table 17). The effect of cattle and population density is positive as expected. Cattle provide the manure to use and population pressure reduces the size of land holdings and increases land value, which promotes investments in land improvement. The negative effect of age of household head on manure application to coffee suggests that older farmers are less likely to apply manure on coffee than their younger counterparts. This may be a result of the labor-intensive nature of manure application, which requires young people full of energy. It is may also be associated with clonal coffee production which is a recent phenomenon that

is likely to have been more adopted by younger farmers because of its high labor and external input requirement.

Presented in Table 18 are the results of Tobit model estimation on factors affecting the probability and intensity of use of improved maize varieties. The effect of membership to organizations and distance to nearest markets is as expected, although market access and proportion of family members above 12 years of age have negative effects contrary to apriori expectation. The explanation for proportion of family members above 12 years is similar to that given for manure use on bananas. It is hard to explain why market access would reduce adoption of improved maize seed. It is probably associated with presence of better paying alternatives in areas with better market access. The positive effect of organizations on adoption of improved maize varieties suggests that some organizations are promoting their use. The recommendation here is that these organizations should also promote the use of nutrient replenishing inputs so that increased maize production in the lakeshore region does not come at a cost of increased land degradation.

The insignificant factors appearing in the models (see Tables 16 to 18) are not discussed in the text. Other factors such as land tenure, savings and access to formal or informal credit that were hypothesized to affect level of external inputs use (intensification) are not analysed in the models because of having very few observations.

VI. Conclusion and Policy Implications

During the past decade, several households in the lakeshore region have scaled down on non-farm activities (such as salary/wage employment and trade in non-agricultural goods) and embraced agricultural production and trade as their primary income source. These changes are more the result of unfavorable trends, shocks and seasonality in people's livelihoods (rather than positive ones), and are an attempt to cope with these unfavorable situations.

The production of several crops and livestock has gained importance, the most notable ones being cattle, pigs, chicken, perennial (matooke and coffee) and annual crops (maize and beans). Associated with the production of annuals (especially maize), however, is increased nutrient mining through increased exposure of the soil to erosive forces and nutrient exports from the farm through commercialization, unless external inputs (such as in organic fertilizers, manure, compost, etc.) are used to replenish these nutrients. Unfortunately, the information presented in this paper shows that the level of use of such inputs on annuals (maize and beans) is near zero, although a few farmers are using manure and compost on perennials (matooke and coffee). Instead, a significant number of farm households are growing improved (higher-yielding) varieties of these annuals, which take out more nutrients from the soil than the low-yielding unimproved varieties, without replacing them. Moreover, a significant proportion of the annuals (maize in particular) is sold for cash, leaving no chance of recycling the nutrients lost through harvesting. The end result is bound to be faster and further reaching land degradation.

Several factors have been hypothesized as deterring farmers from pursuing the intensive pathway, which involves increased use of external inputs in agricultural production. These include lack of supporting systems such as credit, extension, or agricultural training programs, lack of labor and capital or savings (poverty), and land tenure security. However, the effect of a few of these variables such as land tenure, access to credit and savings has not been analysed in the econometric models because of the problem of small number of observations on these variables. But judging from the way the few available formal credit sources are shunned by rural households (and from the small loan amounts acquired mainly from informal sources most likely to meet consumption and emergency cash needs) it is unlikely that credit has affected intensification in the lakeshore region. Also judging from the predominant forms of saving used (crop produce, livestock and keeping money at home), it is unlikely that the improved saving culture has affected intensification.

The results of the Tobit and Probit model estimations show that livestock ownership (particularly cattle), contact with extension agents and market access significantly enhance the use of manure on bananas. Thus, improving farmers' access to markets through investments in rural road construction and maintenance as well as transportation is likely to result in improved land management in the Lakeshore region. The positive influence of livestock ownership and access to extension on manure use suggests that extension services are correctly using the opportunity of increased livestock acquisition (especially cattle) in the Lakeshore region to promote the use of manure on bananas. This effort needs to be expanded to include other types of livestock (such as chicken) and

crops (such as maize) to ensure that synergies between all crops and all livestock are fully exploited to improve land management in the region.

The negative effect of farm size on manure use suggests that smaller farms are more likely to use manure than bigger ones. Thus, population pressure, which reduces farm size doesn't necessarily promote land degradation as the Malthusian pessimists have always argued, but may instead stimulate investments in land improvement. As a matter of fact, population density significantly enhances the use of manure on coffee, although its effect on bananas is negative and insignificant.

The higher the proportion of household members in the productive age group (above 12 years of age) relative to the entire population of the household the less likely is that household to use manure or improved maize seed. This contradicts apriori thinking that this category of family members, which constitutes family labor, should promote the use of labor-intensive technologies. It may be associated with increased school attendance of children in this age category or increased involvement in non-farm activities as the returns from using labor on a fixed land resource diminish with increasing family size. Further research is needed to provide a better understanding of this relationship.

Membership in organizations is associated with increased use of improved maize seed, suggesting that this technology is being promoted by some organizations in the Lakeshore region. However, the limited use of soil fertility replenishing inputs associated with maize production implies that these organizations are not promoting the

use of these inputs as much as they are promoting improved seed. This is bound to deplete soil fertility in the long run and it is critical that such organizations put as much emphasis on soil fertility management as they do on improved seed.

The results presented in this paper are not conclusive and should be treated as being preliminary. Further analysis of the survey data (plot and household) needs to be done to validate these findings and provide greater confidence in explaining the changes in livelihood activities in the lakeshore banana-coffee farming system and how these changes have impacted on land management.

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APPENDIX TABLES

Table 1 Primary and Secondary Income Sources in 1990 and 2000

INCOME SOURCE	% of households reporting as primary income source		% of households reporting as secondary income source	
	1990	2000	1990	2000
	N=135	N=135	N=135	N=135
Production and Sale of crops	51.11	67.41	33.33	34.07
Salary/Wage employment and non-agricultural family business such as transportation, shop/kiosk, etc.	20.00	11.85	13.33	22.22
Production and sale of livestock and livestock products	5.19	6.67	10.37	11.11
Production and sale of Forestry Products	2.96	0.74	2.22	2.22
Trading in Agricultural inputs and outputs	11.85	13.33	16.30	19.26

N=Number of observations
Numbers in parentheses are standard errors

Table 2: Income Share and Level of Commercialization of Emerging Livelihood Activities

ACTIVITY	% of households pursuing activity		% of total production sold in 2000	share of total crop income in 2000
	Dec. 1990 (N=135)	**Dec. 2000 (N=135)**		
Cattle keeping	39.42	48.91	-	-
Pig Farming	15.33	29.93	-	-
Poultry Farming	48.91	61.31	-	-
Banana Production	64.4	80.0 (67.0)*	11.74(1.91)*	15.56(2.43)*
Coffee Production	44.4	62.96	47.54 (4.69)**	21.91(3.76)
Maize Production	69.63	91.11	29.21 (3.42)	21.92 (2.91)
Beans Production	63.70	85.19	14.08 (2.405)	5.03 (0.835)
Vegetables Production	-	15.56	-	-
Beer brewing	-	15.33	-	-

N=Number of observations
Numbers in parentheses are standard errors
*The 1990 figure of % of households producing bananas (64.4%) includes all banana types (cooking, beer, desert). In 2000, the % of households producing bananas was 80 (for all banana types) and 67 (for cooking bananas only). The figures for % of total production sold and share of total crop income in 2000 are for cooking bananas only.

**47.54% (less than 100%) of the coffee produced in 2000 was sold in the same year. The rest was sold later

Table 3.Reasons for Change in Primary and Secondary Income Sources Between 1990 and 2000

	% of household members attributing change in primary income source to							% of household members attributing change in secondary income source to						
INCOME SOURCE	**N.A (N=135)**	**Vulnerability factors (N=135)**		**Capital (N=135)**		**Policy factors (N=135)**	**Other (N=135)**	**N.A. (N=135)**	**Vulnerability Factors (N=135)**		**Capital (N=135)**		**Policy factors (N=135)**	**Other (N=135)**
		(+)	**(-)**	**(+)**	**(-)**				**(+)**	**(-)**	**(+)**	**(-)**		
Production and sale of crops	41.76	9.90	22.0	3.30	8.80	2.20	12.10	43.48	6.50	30.43	4.35	4.35	2.17	8.70
Salary/wage employment and non agricultural farm business	37.50	12.50	25.00	0	12.50	6.25	6.25	46.67	6.67	16.67	0	13.33	3.33	10.0
Production and Sale of livestock and livestock products	33.33	22.22	44.44	0	0	0	0	46.67	13.33	20.0	0	13.34	0	6.67
Trading in Agricultural outputs and inputs	44.4	0	33.33	0	5.60	0	16.67	38.46	15.40	19.23	3.85	0	0	23.05

N.A = Not applicable that is, Primary and Secondary income source did not change for the respondent household.
N=Number of observations

Table 4. Level of Intensification in Livestock Production

LIVESTOCK TYPE	% of households with livestock type		% of households with improved breeds of livestock	
	1990 (N= 135)	2000 (N= 135)	1990 (N = 35)	2000 (N= 135)
CATTLE	39.42	48.91	8.8	12.4
PIGS	15.33	29.93	0	0.7
CHICKEN	48.91	61.31	1.46	2.9

N= Number of observations

Table 5. Level of Intensification for Perennials and Storable Annuals in 2000

CROP CATEGORY	% of households that grew crop		% of households that used improved varieties		% of households that used inorganic fertilizer on crop		%of households that used manure on crop		% of households that used compost on crop	
	FIRST SEASON	SECOND SEASON	FIRST SEASON	SECOND SEASON	FIRST SEASON	SECOND SEASON	FIRST SEASON	SECOND SEASON	FIRST SEASON	SECOND SEASON
	N= 136	N= 136	N= 132	N=129	N=132	N= 129	N= 132	N= 129	N= 132	N= 129
MAIZE	72.18	69.9	44.36	39.85	0.76	2.33	2.27	3.10	0	0
BEANS	60.90	53.4	28.57	25.56	0	0	0	1.55	0	0
BANANAS	67.67	67.67	-	-	0	0	18.94	15.50	6.82	6.98
COFFEE	57.14	57.14	-	-	1.52	0	9.85	9.30	0.76	0.78

N= Number of observations

Table 6. Average Quantities of Inputs used for Perennials and Storable Annuals in 2000

CROP CATEGORY	Improved seed (kgs)	Inorganic fertilizers (kgs)	Manure (kgs)	Compost (kgs)
MAIZE	7.93 (1.36)	(-)*	19.09 (12.22)	0
BEANS	6.59 (1.21)	0	5.07 (4.75)	0
COOKING BANANAS (MATOOKE)	-	0	417.41(189.53)	50.71 (25.42)
COFFEE	-	(-)*	152.17 (61.30)	(-)*

* Very few observations ; Numbers in parentheses are standard errors

Table 7. Access to Credit in 1990 & 2000

	2000	1990
% of households that applied for formal credit (N=137)	18.98	2.19
% of households that applied for informal credit (N=137)	64.96	33.58
% of households that applied and received formal credit	92.3(N=26)	100 (N=3)
% of households that applied for and received informal credit	97.8 (N=89)	95.6 (N=46)
Average value of cash loan (credit) acquired (Ushs)	124,658 (34,918)	
Average value of in-kind loan (credit) acquired (Ushs)	4,040 (1,376)	-

N=Number of observations
Numbers in parentheses are standard errors

Table 8. Primary and Secondary Forms of Saving in 1990 and 2000

	% of Households reporting as primary form of saving		% of household reporting as secondary form of saving	
Form of saving	1990	2000	1990	2000
	N=135	N=135	N=135	N=135
1. Deposit with banks	15.56	8.89	0	2.96
2. Keep money at home	13.33	16.30	30.0	18.52
3. Purchase livestock	17.04	28.89	23.0	18.52
4. Purchase land	2.96	3.70	2.0	2.22
5. Store crop produce	12.59	11.85	11.0	11.85
6. Percentage of households that saved in whatever form (N=135)	1990		2000	
	83.70		97.78	

N=Number of observations

Table 9. Membership in Organizations and Committees

Category of Organization or Committee	% of households participating in organization activities (N=137)	% of household members in organization category	Average number of household hours spent in activities of organization category
Credit	27.01	8.891 (1.869)	26.874 (7.105)
Informal Education and Training	13.14	4.549 (1.283)	29.348 (12.907)
Natural Resource Management	4.38	1.586 (0.696)	8.323 (3.997)
Marketing of agricultural Produce	4.38	0.461 (0.236)	0.591 (0.320)
Agricultural Production	10.95	3.441 (1.232)	32.071 (17.616)
Funeral	31.39	12.461 (2.542)	45.836 (11.159)
Others	40.15	13.725 (2.486)	89.410 (19.343)

N=Number of observations
Numbers in parentheses are standard errors

Table 10. Agricultural Training and Extension in 2000

AREA/SUBJECT OF TRAINING/EXTENSION	% of households that received training in area (N=137)	% of household members who received training in area	% of households that received extension on subject (N=137)	% of household members who received extension services on subject
Crop Agronomy	66.42	40.083 (7.295)	17.52	4.977 (1.250)
Plant Protection	16.79	6.491 (1.738)	5.84	0.785 (0.333)
Soil and water conservation	22.63	4.680 (1.061)	8.03	2.140 (0.907)
Livestock Management	6.57	0.709 (0.299)	0	0
Horticulture	8.76	2.144 (0.793)	4.38	1.421 (0.631)
Marketing of Agricultural Produce	6.57	1.454 (0.541)	0	0

N=Number of observations
Numbers in parentheses are standard errors

Table 11. Land Tenure and Titling

CATEGORY	
Average % parcels with titles	6.945 (2.002)
Average % of parcels held under freehold tenure	21.571 (3.799)
Average % of parcels held under leasehold tenure	5.735 (1.745)
Average % of parcel held under mailo tenure	48.483 (4.828)
Average % of parcels held under customary tenure	22.004 (3.785)

Numbers in parentheses are standard errors

Table 12. Demographic Characteristics of the Surveyed Households

1.	Average Family Size	10.88 (0.520)
2.	Average % of hh members>12 yrs old	59.71 (2.126)
3.	% Male-Headed households	90.37
4.	Average age of household head	44.75 (1.488)
5.	Average % family members with no schooling	0.183 (0.130)
6.	Average % some primary education	46.67 (2.70)
7.	Average % completed primary education	18.957 (2.108)
8.	Average % completed secondary education	16.204 (1.457)
9.	Average % completed 'O' level	6.837 (1.235)
10.	Average % completed 'A' level	1.644 (0.521)
11.	Average % completed or had some post secondary education	1.926 (0.652)
12.	Average total of value of agricultural produce disposed (Ushs)	541,268 (70,711)
13.	Average household income from non-agricultural sources such as petty trade, remittances, etc	470,144.8 (108,093)
14.	Average distance from land parcel to the nearest market (Kms)	4.767 (0.383)
15.	Total land endowment (Area) in Acres	8.242 (0.9027)
16.	Average number of parcels owned	2.21 (0.13)
17.	Average area per parcel in acres	4.320 (0.436)

N=Number of observations
Numbers in parentheses are standard errors

Table 13. Livestock Owned and Value in 1990 and 2000

ANIMAL TYPE	% of households with livestock type (N=135)		Average Number. (Dec. 2000)	Average Value (Ushs) (Dec 2000)	Average Number (Dec1990)	Average Value (Ushs) (Dec.1990)
	1990	2000				
CATTLE	39.42	48.91	2.838 (0.794)	493,209 (109,1620	2.507 (0.488)	313,602 (67,080)
PIGS	15.33	29.93	0.926 (0.171)	24,407 (7,580)	1.549 (0.893)	20,589 (7,397)
POULTRY	48.91	61.31	11.765 (4.829)	34,773 (16,992)	13.393 (5.949)	35,025 (18,304)

N=Number of observations
Numbers in parentheses are standard errors

Table 14. Import and Export of Agricultural Labor in 2000

Labor Category	Average Person-Hours	Average Value (UShs)
Imported labor	687.158 (127.109)	144,785 (30,385)
Exported labor	133.382 (46.580)	85,409.59 (38,630.45)

N=Number of observations
Numbers in parentheses are standard errors

Table 15 Value of Household Equipment and Durables in 2000 and 1990

Equipment category	Average Value (Ushs) in 2000	Average Value (Ushs) in 1990
Transport equipment (e.g. motor vehicle, bicycle)	98,341.89 (22,348.91)	75,663.7 (22,915.37)
Household durables (e.g. radio, furniture)	28,548.06 (2,909.25)	20,356.35 (2,807.58)
Crop production equipment	22,720.23 (3,895.65)	12,667.8 (2,548.8)
Livestock Production Equipment	1,528.28 (1,029)	(-)*
Other equipment	2.744.419 (1,958.658)	1,604.77 (1,602.02)
All household equipment and durables	155,443.7 (24,456.86)	111,240.9 (24,916.35)

N=Number of observations
Numbers in parentheses are standard errors
*Very few observations

Table 16. Determinants of Manure Use on Bananas in the Lakeshore region

Factor#	Impact	P
Market Access	+	*
Population Density	-	NS
Proportion of household > 12 years	-	***
Age of household head	+	NS
Education of household head	+	NS
Value of imported labor	+	NS
Distance to nearest market	-	NS
Total Land Area	-	**
Pig ownership	+	***
Chicken ownership	-	NS
Cattle ownership	+	*
Contact hours with extension agents	+	**
Hours spent in organization activities	-	NS

Details of the full Probit model results may be obtained from the author upon request. Sex of household head being male predicts failure perfectly, therefore not used in the model.
P shows the significance of the impact associated with the factor *,**,*** mean that the impact is significant at 10%, 5% and 1% levels, respectively. NS means the impact is not statistically significant at the conventional levels of significance. + and - means positive and negative impact, respectively.

Table 17. Determinants of Manure use on Coffee in the Lakeshore Region

Factor#	Impact	P
Market Access	+	*
Population Density	+	*
Proportion of household > 12 years	-	NS
Education of household head	+	NS
Age of household head	-	**
Value of imported labor	+	NS
Distance to nearest market	-	NS
Total Land Area	-	NS
Pig ownership	-	NS
Chicken ownership	+	NS
Cattle ownership	+	***
Contact hours with extension agents	-	NS
Hours spent in organization activities	+	NS

Details of the full Probit model results may be obtained from the author upon request. Sex of household head being male predicts failure perfectly, therefore not used in the model.
P shows the significance of the impact associated with the factor *,**,*** mean that the impact is significant at 10%, 5% and 1% levels, respectively. NS means the impact is not statistically significant at the conventional levels of significance. + and - means positive and negative impact, respectively.

Table 18. Determinants of Adoption and Intensity of Use of Improved Maize Varieties

Factor#	Impact	P
Market Access	-	*
Population Density	+	NS
Proportion of household > 12 years	-	**
Education of household head	+	**
Age of household head	+	NS
Value of imported labor	+	NS
Distance to nearest market	-	*
Total Land Area	-	NS
Contact hours with extension agents	+	NS
Hours spent in organization activities	+	*
Sex of household head	-	NS

Details of the full Tobit model results may be obtained from the author upon request.

P shows the significance of the impact associated with the factor. *,**,*** mean that the impact is significant at 10%, 5% and 1% levels, respectively. NS means the impact is not statistically significant at the conventional levels of significance. + and - means positive and negative impact, respectively.