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THE PUZZLE OF IDLE LAND IN THE DENSELY POPULATED KIGEZI HIGHLANDS OF SOUTWESTERN UGANDA

***Bamwerinde W.*[*], *B. Bashaasha*[**], *W. Ssembajjwe*[#] *and F. Place*[##]**

We characterize land use at the household level and identify two types of long-term uncultivated lands–those that are intentional fallows and those that are neglected or abandoned. We then use a multinominal logit model to examine the determinants of plot abandonment and long fallows in order to propose policy interventions that lead to optimal and sustainable management of land use systems in Kigezi highlands. Household factors such as age, and formal education positively influenced farmers' decision to abandon plots.. However, farm size and household type had no significant influence on abandonment of plots. Plot variables such as slope and distance between the homestead and the plot had the expected positive signs while soil fertility had a significant negative sign as predicted. From the analysis different typologies of uncultivated lands were defined depending on their inherent characteristics and distance to the homestead. Farmers then provided technological and policy options as to how these types of plots could be made more productive.

BACKGROUND

The development of the agricultural sector in Kigezi highlands in South Western (SW) Uganda has involved progressively more intensive use of land resources for cropping and grazing leading to unsustainable adaptation and changes in land use. Restoration of soil productivity in Kigezi highlands had relied on natural fallow practices and subsequent natural resource regeneration. However, existence of large proportions of uncultivated land in such densely populated area is evidence that some of this may be unintentional fallows (AFRENA, 1999). What is observed appears contrary to the expectation of increased annual cultivation in land scarce areas as postulated by the theory of induced innovation (Boserup, 1965). Some authors have suggested that the increased area under long fallows could be a farmer's management

* Forestry Research Resources Institute of the National Agricultural Research Organization, P.O Box 311, Kabale, Uganda.

** Department of Agricultural Economics and Agribusiness, Faculty of Agriculture, Makerere University, P.O. Box 7062, Kampala. E-mail: bashaasha@agric.mak.ac.ug; agecon@agric.mak.ac.ug or aspsmuk@infocom.co.ug.

Department of Forest Management, Faculty of Forestry and Nature Conservation, Makerere University, P.O. Box 7062, Kampala

World Agroforestry Centre, P.O. Box 3067700100, Nairobi, Kenya.

strategy to improve natural resource management and particularly fertility regeneration (Lindblade *et. al.*, 1998). Others have argued that disuse is because plots are very heterogeneous with some being very unproductive in terms of crop yields despite effort to increase production. Another explanation is that poor land markets could be inhibiting farmers from acquiring land that they would put into use and disposing of land that they have abandoned. Despite the above explanations, the economic determinants, causes and extent of land use decisions by farmers are not well understood.

As a result, there are as yet no agreed upon interventions to address the issue. In order to understand the impact of human activity on the highland ecosystem, it is important to identify and estimate the factors that influence farmers' decisions to put land to particular usage. Therefore, the main objective of this study is to determine the present status and causes of land abandonment in Kabale District, and propose policy options for sustainable management of land resources.

The Kigezi highlands are a region of high agricultural potential but with a high population density (about 300 per km^2) and population growth of about 2.2% per annum (Ministry of Finance, Planning and Economic Development, (MFPED, 2004). The highlands lie in SW Uganda at an altitude of 1500-2700 meters above sea level. The rainfall pattern is bimodal and ranges from 1000 to 1500 mm per annum. The temperatures are moderate with mean minimum of 13^0C and mean maximum of 23^oC. In Kigezi, soils are generally volcanic and were inherently fertile although some parts have less fertile Ferrasols and Andosols (Djimbe and Hoekstra, 1987).

PREVIOUS WORK ON FARMERS LAND USE DECISIONS

In this research, the practice of leaving land to rest for longer periods than the farmer would have desired (*unintentional fallow)* locally known as "*Eibija*" is what is referred to as abandonment of land. This is opposed to *intentional fallow* that is commonly practiced and known to farmers locally known as "*Hinga raza."* Land abandonment has been observed in several other countries including Botswana, Japan and Lebanon (Mmopelwa, 1998; Arntzen, 1984; Kashiwagi, 1998; Zurayk 1994).

Mmopelwa (1998) empirically examined the proportion and factors causing unintentional fallowing in South East Botswana. He used data from 100 randomly selected farmers and simple statistical estimations. The study revealed that 20% of farmers unintentionally fallowed (short-term or long-term), 1% intentionally fallowed and 79% did not fallow at all. The factors attributed to unintentional fallows were the lack of draught power (86%), labor (82%) and rainfall variability (100%). Based on these findings two aspects of fallowing were noted. The first aspect was intentional fallowing, in which farmers purposefully left their land uncultivated for it to regain soil fertility. The second aspect was that of unintentional fallowing whereby farmers involuntarily leave their land uncultivated due to biophysical, social and economic factors beyond their control.

Grisley and Mwesigwa (1995) investigated the socio economic factors that influence seasonal fallowing in Kigezi highlands. The study revealed that 76% of farmers reported some cropland in grass fallow. Households reported an average of 26% of cropland under fallow. Model estimates revealed that intercropping and farm size were highly associated with the land fallowing

decision but distance to fields was not. They recommended use of capital-intensive technologies such as terracing, agroforestry and use of chemical fertilizer, though currently unavailable, to overcome the problem of land being idle for a long time.

An empirical study by Barbier (1998) used a bio-economic model to investigate the theory of induced innovation and land degradation in the intensively cultivated areas of West Africa. The results of this study show that farmers prefer extensification to intensification even if land is marginal and produces lower yields. Under population pressure, the model revealed that over time soil organic matter and soil nutrients become scarce and the cost of land degradation increases. However, if the population is constrained and continuously farms the same plots, the economic results and welfare deteriorates especially when existing markets and technologies for agricultural improvements are limited.

The changes in land use system in Kabale District in Kigezi highlands between 1945 and 1996 as well as the current farm management practices were investigated by Lindblade *et. al.* (1998) using transects conducted in 1945 as baseline for measuring land use changes. They observed significant increase in area under fallow since 1945. For example, 19% of plots were left to fallow in 1945 as compared to 32% in 1996. Furthermore, the length of the fields rested had extended significantly with 95% left to fallow for more than half a year in 1996 compared to only 5% in 1945. Households with more than 11 plots reported 31% of their plots under fallow while farmers with less than 5 plots could fallow up to 25%. Finding more fallow to day compared to 1945 is perplexing given the perceptions of the local people. Rapid appraisal exercises conducted by various researchers reveal consistently that the perception of local people is that land fallow periods have decreased or are non-existent for some farmers. One reason could be due to definitions and assumptions: Lindblade *et. al.* (1998) considered all uncultivated plots as fallowed.

ANALYTICAL FRAMEWORK

The five land use options analyzed in this study include continuous cropping, short fallow, long fallow, woodlots and abandonment. At an individual farm level, decisions on whether to use a given plot of land for annual production or to put it under other land use options such as long fallow and woodlot is assumed to depend on the net present value of the option available to the farmer. For example, the practice of continuous cultivation with intermittent short duration fallows would only continue if normal returns on fixed capital would be obtained after all farm running costs have been paid. Continuous crop production and short fallow involves a modest capital investment, are short term in nature (0-1 year), and can result in optimal use of the plot if well managed (e.g. with adequate nutrient inputs). However, if land resources become depleted, potential future profits will be reduced until ultimately the plot is fallowed or put to some other land use option that would be less profitable in comparison to cropping if land was not degraded. Because the use of fertilizer is very low in Uganda as a whole, Kigezi no exception, the possibility that land become degraded with continuous use is real.

Fallowing is a land management strategy to intentionally increase soil productivity in the medium term (1-3 years). Consequently, land fallowing is an investment decision. This study argues and tests the proposition that not all farmers can afford this medium-term investment

and therefore some of the plots that appear to be in fallow are in reality abandoned because of unintentional sub-optimal usage by farmers. The complexity between plot abandonment and long fallowing is that both practices appear to be indistinguishable by observation but based on different decisions. Therefore, long fallow, woodlots and abandonment decision by farmers are treated as different forms of long-term investment.

We assume that plot characteristics that affect productivity or the net returns will affect land use decisions. For example, plots of inherently poor soil fertility would be less likely to be put to into cultivation compared to other plots. The distance to the plot will also generate differences in labour costs and risks (e.g. of crop theft) and affect land use decisions. Household factors such as access to resource (e.g. labour, land) will also affect the net returns from the portfolio of plots and affect general land use decision-making at the farm level. As will be shown below, farms are characterized by extreme land fragmentation, with households owning 6 -10 plots widely scattered on the landscape. Thus, the possibility that a household will face widely varying net returns to an identical investment on their different plots is high. Farmers may also opt to abandon the plot after a short fallow. In some cases, farmers could revert land previously abandoned back to cropping depending on the availability of inputs.

ECONOMETRIC MODEL OF LAND USE DECISIONS

We estimate an econometric model of land use decisions using a snapshot or cross sectional data. The dependent variable (land use options) has five response levels representing the current land use option of a given plot. These are continuous cropping, abandonment, woodlot, long fallow and short fallow. The covariates include age of the household head, farm size, plot distance from homestead, household size, education level of the household head, gender of household head, polygamous or not, plot location, soil fertility status, presence of stones, plot size and slope. The logistic model is generally specified as follows;

$$Y_i^* = \beta' X_i + \varepsilon_i \qquad (1)$$

Where, Y_i^* is the underlying latent variable that indexes the land use option on a given plot. X_i is a (kx1) vector of explanatory variables, β is a (kx1) vector of the parameters to be estimated, and β_i is the stochastic error term.

A general expression (Greene, 2003) for the conditional probability for the five land use options (categories) is:

$$P\,(Y = j)\,\Big|\, X = \frac{e^{g_j(X)}}{\sum_{k=0}^{4} e^{g_k(X)}} \qquad (2)$$

Where j is the category of land use. From this specification, the probabilities for each of the observed responses are easily derived.

1. Empirical Model

The model used to estimate the influence of plot and household characteristics on land use choices is specified as follows:

$$A = \beta_0 + \beta_1 \, FARMSIZE + \beta_2 \, HHSIZE + \beta_3 \, AGEHH + \beta_4 \, HHPMALE + \beta_5 \, HHFEMALE + \beta_6 \, EDUCPRIM + \beta_7 \, EDUCPOST + \beta_8 \, FERTMOD + \beta_9 \, FERTGOOD + \beta_{10} \, TOPMID + \beta_{11} \, TOPTOP + \beta_{12} \, STONFEW + \beta_{13} \, STONMANY + \beta_{14} \, SLOPMOD + \beta_{15} \, SLOPSTP + \beta_{16} \, PLOTSIZE + \beta_{17} \, PLODIS + e$$

Where;

A = Land use option (continuously cropped plots, short fallow, long fallow, abandonment and woodlots).

FARMSIZE	The total land holdings measured in hectares
HHSIZE	Number of household members measured in number of persons
AGEHH	Age of the farmer measured in years
HHFEMALE	Households headed by female (base case is monogamous households headed by males)
HHPMALE	Polygamous households measured as number of women living with the head.
EDUCPRIM	Household heads with education level of primary (base case is no formal education)
EDUCPOST	Household heads with education levels of post-primary or more
FERTGOOD	Terrace plots with good soil fertility
FERTMOD	Terrace plots with moderate soil fertility (base case is plots with poor soil fertility)
TOPMID	Terrace or plot is located in the mid slopes
TOPTOP	Terrace plots located on landscape (base case is valley bottoms)
STONFEW	Plot has few stones (base case is plots with no stones)
STONMANY	Plot or terraces has many stones
SLOPMOD	Plot or terrace is on moderate slope (base case is flat plots)
SLOPSTP	Plot or terrace is on steep slope
PLOTSIZE	The plot size in hectares
PLODIS	The distance of the plot from the home measured in Km

2. Selected Variables for Model

Several exogenous or predetermined household variables are included in the model. The age of the household head is included because the probability of plot abandonment may differ with age. However, the relationship may move in different directions. Land markets exist, but are imperfect so older farmers may have had more opportunity to dispose of unwanted plots or

have accumulated more wealth so as to avoid abandonment. On the other hand, they may have acquired many plots and found that they cannot adjust their land holdings as quickly as other factors like labor or capital have changed.

Household size, sex of household head, polygamous households, and education of household head are also included. Household size is hypothesized to have a negative relationship with abandonment. Female-headed households are hypothesized to be more prone to abandonment than male-headed households because of their difficulty in exercising rights or acquiring necessary factors of production. Educated farmers (especially those with post-primary education) are expected to have acquired knowledge in relation to improved methods of land management. They also have the ability to acquire loans to improve the land. However, they are also capable of diverting the resources to non-agricultural activities perceived to offer higher returns. This therefore may lead to less investment in soil improvement and increased land abandonment. Therefore, a priori the hypothesized sign is unclear.

The plot related variables included in the model were TOPTOP (plot on a hilltop) and TOPMID (plot on a mid-slope) with plots in the valley bottom acting as a base. Although both represented the topographic location of the plot, they are entered as separate variables because they are expected to influence abandonment of plots differently. It is expected that plots located on the hilltop are more likely to be abandoned compared to plots in the valley bottom because of poor accessibility. The plots in the mid slope are more likely to be either short fallowed or long fallowed because they are closer to the homes. The degree of soil fertility of a plot influences land use decisions. The variables FERTMOD (moderate soil fertility) and FERTGOOD (good soil fertility) are entered separately as dummy variables and plots with poor soil fertility acted as the base case. It is hypothesized that soil fertility is negatively related to abandonment. Therefore, both soil fertility variables are both expected to have negative signs.

The influence of plot stoniness on farmers' decision to abandon or cultivate the plots is also investigated. STONFEW (few stones) and STONMANY (many stones) are variables entered separately because many stones are hypothesized to encourage abandonment since it is difficult to open the soil (absence of stones is the base and omitted case). Absence of stones is expected to encourage continuous use of the plot. Therefore, the hypothesized sign is positive for STONMANY and STONFEW, but weaker in the latter case. The slope of the plot is also a characteristic expected to influence the use of the given plot. The slope variables are SLOPMOD (moderate slope) and SLOPSTP (steep slope). They are entered as separate variables and flat plots are used as base cases to verify the influence of slope on abandonment. The steeper the plot, the more difficult it is to cultivate and improve, hence greater slopes are expected to have a positive sign.

The hypothesized sign is positive for FARMSIZE and negative for PLOTSIZE. The larger the farm, the less likely it will be for a farmer to keep all of it in continuous cultivation, ceteris paribus. Larger plots have a negative sign and are expected to act as incentives for farmers to travel long distance and use the plots despite fragmentation. The variable (PLOTDIS) represents the distance from the homestead to the plot. It is hypothesized to have a positive sign. The further away the plot was from the home, the higher the probability of it being abandoned or long fallowed.

3. Data and Sources

To estimate the model, data were collected from 3 sub counties in Kabale district. Kabale district with a total land area of about 1850 km^2 has three counties and 19 sub counties. In each county, two sub counties were selected making a total of six sub counties. These included Kashambya, Kamwezi, Rubaya, Maziba, Bubale and Hamurwa sub counties. The unit of analysis in this study was a farmer's plot, but data were also collected on the farming household. Since factors related to plot abandonment were analyzed, a plot was used because it is the smallest unit of land on which cultivation takes place.

In order to allow for a wider coverage and representativeness, a random sample of respondents was used. Selection of sub-counties and parishes was undertaken using multistage simple random sampling. Twenty farmers were randomly chosen from each locality while 60 farmers were taken from each sub county. Interviews were carried out in 18 parishes. Data were collected from a total sample of about 360 households through use of a structured questionnaire and plot visits. Given the number of plots per household in the district, over 2,530 plots were covered in the survey.

EMPIRICAL RESULTS

1. Extent of Abandonment and Land Use Options

The current use of plots by farmers reveals that about 59.6% of the 2,530 plots are cultivated with crops. The short fallow and long fallow comprise of 8.1% and 13.7% respectively. The abandoned plots by farmers are about 10.1% of the total plots visited. The plots with woodlots comprise about 8.1%.

Farmers' reported that poor yields are the main reason for both long fallow and abandonment of fields. The survey reveals that of roughly one-quarter of plots either long fallowed or abandoned, 61% was due to soil fertility problems. Livestock grazing (10%), location of fields (11%), labor shortage by households (9%) and old age (2.3%) are also important factors for non-cultivation. Other reasons given include bush fires and farmers poor health that affected about 3% of the plots surveyed.

The results (Table 1) reveal that the average distance of plots from the homestead and roads is about 1.15 km and 1.5 km respectively ranging from 0 to 20 km. Because of the terrain, even when distances are small, it is difficult to reach the plots that look to be near homes. The mean distances to market from plots was 6 km. The average number of plots owned by the household head is 8 plots and ranges from 1 to 20 although scattered over the landscape. This scattering of land though sometimes used as a risk management strategy may partly lead to sub optimal usage of the plots.

The mean household farm size is about 10 acres (4ha). This appears to be on the high side compared with existing data, which reports the average land holding as less than 1 hectare. Examination of data and the land use system suggest that an average land holding of less than 1 hectare per farmer in the Kabale district could be an underestimate. This appears to be based on the total land area divided by the total number of farm households, which does not cater for

the land farmers own on the hillsides. Furthermore, unless one visits the plots, farmers tend to report fewer plots. Farmers tend to report only plots they use gainfully rather than plots lying idle.

Table 1
Variations in Factors that Influence Farmers' Land Use Decisions

Factors	*N*	*Minimum*	*Maximum*	*Mean*	*± S.E*
Distance of plot from home	2530	0.00	20.00	01.15	0.03
Total number of plots	2530	1.00	20.00	07.80	0.08
Farm size	2530	0.07	46.00	10.97	0.25
Age of household head	0360	18.0	82.00	45.12	0.27
Household size	0360	1.00	23.00	07.73	0.00
Size of plot	2530	0.03	25.00	01.26	0.04
Area under woodlot	2530	0.00	27.00	00.98	0.148
Area under short fallow	2530	0.00	25.00	00.68	0.119
Area under fallow	2530	0.00	26.00	01.23	0.149
Area abandoned	2530	0.00	57.00	01.07	0.193
Area under crops	2530	0.00	60.00	04.88	0.014

Note: Distance was measured in km, farm size and area in acres.

The mean for household size is about 7 members per household with only 4 active members (55%) who are above 14 years. The rest are either elderly (0.5) or still young (3) members. Apparently, although this could be a good source of farm labor (especially the young) given the fact that universal primary education is in place, this figure leaves few members available for full time labor.

2. Estimates of Determinants of Farmers' Decisions

A single multinomial logit model was run, but because there are five outcomes, the estimates of the determinants of farmers' decisions for each separate category are given in Tables 2 and 3. The coefficients can be interpreted as the change in the log odds associated with a unit change in the respective independent variable. They represent the degree to which a one-unit change in an independent variable induces a change in likelihood from a cultivated plot to one of the other four land uses. Results of the four land uses are presented in the following order, short fallow model, long fallow, woodlot and abandonment models.

Short Fallow Model: The household level variables that are significant for short fallow were FARMSIZE and EDUCPOST. Other significant plot variables included, SLOPMID, FERTMOD, FERTGOOD, PLOTSIZE and PLOTDIS. The short fallow model results show that the odds ratio values for a given plot to be under short fallow are significant for EDUCPOST and FARMSIZE at a 1% level. For example, the odds ratio values obtained for EDUCPOST is 2.26. This implies that as the variable changes from no formal education to EDUCPOST, the odds ratio for the plot to change from cultivated plot to be under short fallow increases more than 2 times compared to that of no formal education, the value of other independent variables held constant.

Table 2
Estimated Coefficients and Odds Ratio for Factors Influencing Farmers' Decisions (Land Use for Short Fallow and Long Fallow)

Factor influencing farmers	*Short fallow*		*Long fallow*	
	Coefficient estimate of the HH/plot factor	*Odds ratio*	*Coefficient estimate of the HH/plot factor*	*Odds ratio*
Intercept	-1.799		-0.767	
AGEHH	0.003	1.002	0.013	1.013**
HHSIZE	0.003	1.003	-0.059	1.060
FARMSIZE	0.026	1.026***	0.005	1.006
EDUCPRIM	0.118	1.125	0.217	1.240
EDUCPOST	0.816	2.260***	-0.013	1.014
HHFEMALE	0.105	1.110	0.488	1.630**
HHPMALE	0.026	1.027	0.445	1.550**
TOPTOP	0.299	1.348	0.279	1.321
TOPMID	-0.723	2.060***	-0.526	1.692***
FERTMOD	-0.486	1.625**	-1.657	5.243***
FERTGOOD	-0.877	2.403***	-2.276	9.738***
STONFEW	-0.230	1.258	-0.172	1.188
STONMANY	-0.359	1.431	0.031	1.031
PLOTSIZE	-0.133	1.142**	-0.017	1.017
SLOPMOD	0.086	1.090	0.225	1.250
SLOPSTP	0.297	1.346	0.294	1.341***
PLOTDIS	0.126	1.134***	0.195	1.215

*, **, *** denotes statistical significance at the 10%, 5% and 1% level respectively.
HH denotes household

Table 2 Estimated coefficients and odds ratio for factors influencing farmers' decisions to either use land for short fallow or long fallow. Analysis was done using multinomial logit function against abandonment, woodlot, short fallow and long fallow based on continuous cultivation.

The plot variables such as TOPMID, PLOTDIST, and FERTGOOD significantly influence short fallowing. For example, the results show that the odds ratio of TOPMID was 2.06 and had a negative sign. This shows that the probability of a plot being under short fallow are 2 times less likely if a plot is located in the mid-slopes relative to the plots in the valley bottom. Other variables such as PLOTSIZE and FERTMOD are significant at the 5% level and have the hypothesized signs. The negative sign on plot size suggests that the larger the plots, the less likely they are put under short fallowed.

Long Fallow Model: Three variables related to household characteristics are significant at the 5% level. These include the age of the household head (AGE), households headed by females (HHFEMALE) and polygamous families (HHPMALE). Relationships between long fallow and age of household head have a positive sign. This implies that long fallow plots are more likely to belong to farmers who are older compared to those who are younger. The odds ratio

value obtained for the variable (HHFEMALE) is 1.6. This shows that the probability (odd values) for a given plot to change from cultivated to long fallow is relatively higher for households headed by females compared to those headed by males. Furthermore, results show that the chance of long fallowing is greater for households with more than one resident wife compared to those with one resident wife.

The most significant variables are related to the plot. The significant differences are observed in soil fertility, location of the plot in the mid-slopes and plot distances at a 1% level of significance. For example, results show that the odds ratio for FERTMOD and FERTGOOD were 5.24 and 9.74 respectively and had the hypothesized negative sign. This implies that the odds ratio value of long fallowing for poor soils is 5 times higher compared to that for plots with moderate soil fertility and about 10 times greater than plots with good soil fertility. Again, the plots under long fallows are more likely to be located far from the homes compared to cultivated plots.

Woodlot Model: The woodlot model results (Table 3) reveal that one household variable (EDUCPOST) is important in determining the farmers' decision to establish woodlots and had the expected positive sign. Farmers with post primary education are more diversified into profitable livelihoods and could afford medium and long-term investments.

Table 3
Estimated Coefficients and Odds Ratio for Factors Influencing Farmers' Decisions (Land Use for Woodlot and Abandoned Plot)

Factor influencing farmers	*Woodlot*		*Abandoned plot*	
	Coefficient estimate of the HH/plot factor	*Odds ratio*	*Coefficient estimate of the HH/plot factor*	*Odds ratio*
AGEHH	0.011	1.012*	0.020	1.020***
HHSIZE	0.019	1.020	0.219	1.245
FARMSIZE	0.097	1.000	-0.006	1.007
EDUCPRIM	0.414	1.513*	0.781	2.184***
EDUCPOST	0.671	1.956**	-0.058	1.060**
HHFEMALE	-0.132	1.141	0.313	1.368
HHPMALE	-0.555	1.742*	-0.398	1.489
TOPTOP	-0.118	1.125	1.073	2.924***
TOPMID	0.243	1.275	0.255	1.290
FERTMOD	-1.950	7.029***	-2.279	9.767***
FERTGOOD	-2.892	18.029***	-2.669	14.425***
STONFEW	0.184	1.202	-0.316	1.372*
STONMANY	1.216	3.373***	0.419	1.520**
PLOTSIZE	0.083	1.087*	0.070	1.073
SLOPMOD	-0.030	1.031	0.739	2.094***
SLOPSTP	0.768	2.155***	0.522	1.685**
PLOTDIS	0.094	1.099*	0.211	1.235***

*, **, *** denotes statistical significance at the 10%, 5% and 1% level respectively.
HH denotes household.

The plot variables that are significant at 1% level include, STONEMANY, FERTMOD, FERTGOOD, and SLOPESTP. Size of the plot is also significant although only at 10% level of

significance. The fact that variables FERTMOD and FERTGOOD, reflecting plots with either moderate or good soil fertility are strongly negative and significant implies that soil fertility was one of the critical determinants for farmers' decision making to use plots for woodlots. Woodlots are more likely to be planted on plots with poor soils compared to fertile soils.

The stoniness is another plot variable that is highly significant. The odds ratio for stoniness in the woodlot model is 3.37. These results show that the odds for establishing woodlot increased to about 3.5 times among plots with many stones than the odds among plots with no stones. The steep slope variable is highly significant at 1% level. Farmers established woodlots on steeper plots as compared to gentler plots. The plot distance variable (PLOTDIS) represents the plot distance from homes. It had a positive sign but is significant only at the 8% level. The further the distance to the plots the more likely one observes a woodlot rather than a cultivated field.

Table 3 estimated coefficients and odds ratio for factors influencing farmers' decisions to either use land for Woodlot or abandon it. Analysis was done using multinomial logit function against abandonment, woodlot, short fallow and long fallow based on continuous cultivation.

Abandoned Plot Model: The significant variables explaining abandonment include both household and plot level variables. Table 3 highlights two household variables that are significant at 1% level. These are age of the household head (AGE) and primary level education (EDUCPRIM). Post primary (EDUCPOST) is significant at the 5% level. The odds ratio value obtained for EDUCPRIM is 2.18. This implies that as the variable changes from no formal education to EDUCPRIM while the value of other independent variables are constant, the (odds) relative chances of a plot being abandoned increases by about 2 times. The sign reverses for post-primary education. Farmers with abandoned plots are more likely to have post primary education compared to those with cultivated plots. Farmers with post primary education may have greater financial resources with which to invest on their land, as shown in the woodlot results.

The plot level variables related to abandonment that are highly significant at 1% level include TOPTOP, FERTMOD, FERTGOOD, SLOPMOD and PLOTDIS from home. The coefficients for the variables moderate soil fertility (FERTMOD) and good soil fertility (FERTGOOD) have the hypothesized negative sign and are significant at a 1% level. The associated odds ratio imply that when the soil fertility changes from poor soils to FERTGOOD the chances (odds) of a plot being abandoned decreases by about 14 times other factors remaining constant. Furthermore, the odd ratio (probability) of a plot remaining under abandonment decreases more (10 times) as the plot changes from poor soil to moderate soil status.

The variable SLOPMOD had the odd ratio of 2.09. This implies that the (odds) probability for the plot to be abandoned are greater when the plot is located on the moderate slopes (about 2 times) compared to the odds when the same plot is located on gentle slopes. Presence of stones (many) and plots on steep slopes are significant at 5% level. Abandoned plots are more likely to be observed on hilltops and mid slopes compared to plots in the valley bottoms. Cultivated plots are more common in the valley bottom and abandoned plots on top of hills. The presence of stones is also another factor that influenced plot abandonment. The odd ratio value is 1.52. This implies that the odds for the abandoned plots are greater (1.5 times) where there is presence of many stones compared with the odds ratio for it where the plots has less stones.

CONCLUSION AND POLICY IMPLICATIONS

The results reveal that plot abandonment and long fallow is a common problem in the Kigezi highlands. Firstly, long fallow and abandoned plots comprises over 25% of the land area. Secondly, while plot characteristics are important in the long run, farmers' attitude, social and economic factors contribute to farmers land use decisions. The findings indicate that household characteristics such as post primary education and households headed by females significantly contribute to farmers' decision to put land under abandonment and long fallow.

What can be done to address the issue of abandonment or low investment depends partly on the specific characteristics of plot. Analysis of the long fallows and abandoned plots show that 26% and 40% of each face multiple constraints to cultivation (e.g. steep slopes and stony). Just under half of each type face one constraint. The remainder, 30% of long fallows and 15% of abandoned plots appear to be highly cultivable. But even here, further analysis found that between 60 – 70% of the cultivable plots are located at least 500 meters from the homestead. This will impinge upon incentives for intensification and investment in valuable or labour intensive systems. For the cultivable plots and nearby plots, there are already available technological options and they can be put into production if resources permit. The large number of plots with physical constraints implies that on the technological side, options that require relatively little labour or management, such as woodlots or fodder production, need to be identified.

There is a further group of uncultivated plots that are far from the homesteads of the current owner. The study reveals that distance to fields hinders productive use of these plots. As a result, policy makers and farmers need to consult and find meaningful ways to encourage free exchange of land, renting and selling of far off plots. This is feasible in the Kigezi highlands because there already exists an active land market. But the same land market has helped to create the high levels of fragmentation on the landscape. The process of improving the spatial distribution of plot holdings will be slow so long as only bi-lateral transactions occur. Thus, the government could play a role in facilitating interested exchangers of land to meet and enable multiple party exchanges to take place.

This study has some limitations. For example, the farm level data on which the findings and recommendations are made are mainly for one season. Data covering more years would be better suited to meeting the objectives of this study. These data would relate more closely to farmers production practices. Because of limitations of time and money, this study focused mainly on Kabale district. While this can be extrapolated for Kigezi highlands, this may not be true for other highland areas in the country because of varying social-economic and climatic conditions.

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