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Socioeconomic Factors Influencing Farm Forestry Investment Decisions in Kenya: The Case of Uasin Gishu and Vihiga Counties

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Abstract
In Kenya, traditional farm landscapes are an overlay agricultural crops livestock and various farm forest formations. Tree growing in agricultural landscapes in the country has a long history. However the intensity has developed over the last 100 years across the country at varying pace and configurations depending on various factors largely driven by demand and supply conditions. Therefore the study was premised on the fact that household land is allocated to tree growing based on the household subsistence needs and extra to satisfy market demands. The study to evaluate the socioeconomic factors that influenced adoption farm forestry by households in two counties in high potential agricultural areas of western Kenya was undertaken in 2015. The two counties were selected for the study differed in various attributes such as settlement history, agricultural land use, farm forestry development and demographic characteristics. Uasin Gishu represents the recently settled former European settler farms and Vihiga represents the former African Reserves settled hundreds of years ago. The study used integrated land use decision making concept to underpin the household production function. The survey involved 260 households that were systematically sampled with questionnaires being administered randomly to households in locations within selected sub counties. The main data extracted from the questionnaire were household land sizes, age of household head, educational levels of household head, cultural factors, farm forest incomes, distance to forest product markets, farm employees, settlement years, household sizes and crop incomes. Data was analysed by use of OLS regression models to generate key farm forestry decision making variables. The results show that the most stable and significant explanatory variables were land size, farm forestry incomes and off-farm incomes. This shows that they were the most important variables in farm forestry land use decisions in western Kenya. The study also revealed that the two counties were significantly different in their farm forestry activities with Vihiga being more intensive as compared to Uasin Gishu. Farm forestry incomes proved to be an importance driving force in scaling up tree growing on individual farms hence indicating the importance of economic objectives on household land use decision making. Farm forest income was stronger in areas where markets and marketing infrastructure were better developed. The study provides some factors that policy makers need to consider in order to positively influence farm forest development in Kenya and other developing countries.
Keywords: Farm forestry, Land use, farm incomes, household decision making

1. Introduction

Kenya has a long history of tree growing on farms that can be attributed to various factors varying from economic objectives to social objectives and many studies have predicted that the future of tree in the country will be on farms (Simons, 2002). Therefore the presumed that households in their land use decisions attempts to maximize income objective in their allocation of resources between forestry and agricultural land uses. However, profit maximization may not be the only factor at play in farm forestry decision-making. This is attested by studies in Central Kenya that showed that despite profitability of tea and coffee enterprises being four times to *Acacia mearnsii* enterprises its growing was widely adopted by many smallholder farmers (Dewees, 1991). Similarly, in the United States studies indicate that population pressure and incomes are significant factors that influence private forestry development (Stoll etal, 1984). In Kenya various studies have shown that the reversal of deforestation through intensive tree growing on farms was as a response to several non-economic and economic factors that include subsistence requirements, markets driven supply/demand for forestry products and income opportunities from forest product sales (Triffen etal,1994; Patel et al,1995; Nyang, 1999;Dewees, 1997, Warner, 1997). Given the complexity of smallholders farm forestry land use decision making process, empirical evaluation of both economic and non-economic variables becomes an important undertaking for more informed understanding and intervention in the sector. The study therefore used integrated approach models to land use decision making in which several key economic and non-economic decisions variables are evaluated for their significant influence on farm forestry land use decision making in the study areas. The paper presents the rationale for integrated approach to farm forestry land use, conceptual framework, estimation methods, results and discussion of major findings.

1.1 Background Information on the study areas.

The selection of the two counties in Western Kenya for the study was based on their diversity in settlement

history, agricultural land uses, farm forestry development and demographic characteristics. Uasin Gishu represents the recently settled former European settler farms and Vihiga to represents the former African Reserves. The socio-economic, demographics and land use history were some of the key factors that shaped land use characteristics hence their farm forestry patterns are distinct and thus need dissimilar farm forestry development approaches and policy formulation.

Uasin Gishu traverses altitude of 2100-2700m above sea level with an area of 3,345km^2, population density of 267/km^2, rainfall of 642-1560mm/year and public forests of 384km^2 of which 64% are commercial plantations. The County is predominantly mixture of large and small-scale commercial and subsistence farming mostly maize, wheat pyrethrum and livestock. The County has strong forestry economy from both farm/private and public forests. Farm forestry is dominated by *A.mearnsii* woodlots for tannin and charcoal production, Cypress and Pines for sawlogs and Eucalyptus for transmission, firewood and construction poles.

The Vihiga County has longer settlement period spanning hundreds of years, is relatively smaller in size measuring 563 km^2, it straddles an altitude of 1300-1800m above sea level and rainfall of 1800-2000mm per year. The county is highly populated with 1,051persons per km^2 making it one of the highest in the country. The county is characterized by subsistence farming and off-farm activities such as employment and retail business. Forestry has long history dating back to 1940s when Eucalyptus species was introduced to reverse deforestation and provide scarce forest materials for domestic use (Humphrey, 1947). Currently it is estimated that Eucalyptus and other trees occupy 30% of the land area with main uses being construction poles and firewood for domestic and surplus for sale (Warner, 1997). The individual land holding can be as small as 0.05 hectares.

1.2 Study methods

The study relied on information and data collected from farm households and key markets in the two counties and wider western Kenya. The survey was divided into three levels: farm, wood based industries and market surveys. Farm surveys involved systematic selection of study locations depending on the importance of farm forestry as a land use to ensure that the sampling units were distributed uniformly over the entire geographical stretch of the counties thus avoiding over-representation as compared to random sampling (Ikiara, 1999). Farmers were randomly sampled within the locations. Data collection was done with help of locally recruited enumerators in the selected locations and markets. The survey teams consisted of enumerators and local foresters and agricultural officers that were assigned to the locations. Each team was to interview farmers randomly in the selected location thus giving each farmer equal chance of being sampled. The main data extracted from the standard questionnaire were land sizes, age of household head, educational of household head, cultural factors, farm forest incomes, distance to forest product markets, farm employees, settlement years, household sizes and crop incomes. Main farm forestry products included in the survey were sawnwood, poles, fuelwood, construction poles and charcoal.

The farm surveys were conducted between June 2015 and March 2016. Those interviewed were mostly household head (husbands), wife, and son and in rare cases farm manager.

Table1: Distribution of Farmers by Counties and Divisions in the study area.

Sub-counties in Uasin Gishu	Farm survey	Sub-counties in Vihiga	Farm survey	
Moiben/Soy	17	Luanda	30	
Ainabkoi	31	Emuhaya	34	
Kesses /Kapseret	29	Tiriki West	14	
Turbo	18	Vihiga/Tiriki West	34	
Total	95	Total	112	Grand total 207

1.2 Integrated Household Models

Integrated household approaches are taken as an alternative to traditional agricultural household models whose objective function is simply to maximize and thus invest in optimal land uses. However, households are influenced by several factors to include financial, environmental, socio-cultural, and institutional structures that have combined effect on alternative production subsystems in the farm. Simple objective function based on optimal control theory only partly explains the complex production system and thus need for alternative approaches. Integrated models which are complex models combining social, economic and biophysical factors that operate in a complex land use systems have increasingly gained importance in recent times in explaining dominance of multiple objective land use systems in most developing countries (Jannssen et al 2000). Emergence of farm forest into an important land use in Western Kenya is as a result of decisions by individuals at farm level leading to structural change currently in place. It is with this view that a need arose for a simple alternative method to supplement the optimal control theory in explaining the existing land use patterns in Western Kenya.

1.3 Conceptual Framework

Multi-objective land use decisions within agricultural landscapes are influenced by multiple factors, objectives, and processes that consciously or subconsciously influences household decisions. Studies in Britain and United States show that large-scale farmers rate economic factors in form of profit and income stability highly only after their fulfilment does social and personal consideration assume importance (Mather, 1986). However, the same study reported that small scale farmers placed more emphasis on non-monetary values than economic factors in their decision making process. Similar studies in England showed that prestige, status, and security were importance elements in range of farmer's social objectives (Gasson, 1973). In Australia studies found that farm forest land use decision was a multiple factor process that varies with the farmer's technical knowhow, socio-cultural and economic conditions (Byron and Boutland,1987). It further reports that the farmer's diversity in motives and core objectives were as diverse as there are farmers themselves, woodlot sizes, and level of management and quantity outputs. This shows that the importance of personal and social objectives compared to economic objectives varies from country to country, location within countries and from individual to individual within locations.

The complexity of farmer's land decision making is compounded array of external factors such alternative land uses, land type, economic conditions, social environment and structural infrastructure in place such as markets, roads, skills and marketing societies. Personal factors such as age, education, personality and needs also influence land uses decisions.

For the purpose the study an integrated household production model encompasses several potential socioeconomic factors that influence land use decision in Western Kenya. The models is developed and tested by regression models. A simple integrated production model assumed for the study is as follows:

$$F = f(P,E,Z,V) \quad (1)$$

Where P is vector price of material output, E environmental values, Z is social objectives and V extrinsic factors. The equation states that farm forestry is a complex function of several attributes to include economic (input & output price, income, material demand/supply), environmental values (amenity, landscape, privacy), social objectives (personality, status, security) and extrinsic factors (biophysical, policy). Every household though assumed by economic rationality to highly rank economic objectives take into account one or more of the other factors depending on the prevailing socioeconomic conditions that may differ from place to place and from individual to individual.

1.4 Analytical Framework

The integrated household production model is assumed to be based on utility maximizing rationale and thus will increase its farm forestry holding and species selection to the extent of its income and consumption needs and other socio-cultural values. The following generalized econometric regression model is developed to represents the farm household integrated production function:

$$Y_i = \alpha + \beta X_i + \mu \quad (2)$$

Where Y_i is the land area under farm forestry of i^{th} households, X_i is the economic and socio-cultural values of household i^{th} that influence adoption of farm forest and μ the stochastic disturbance term. Equation 2 can be expanded into the following general equation:

$$A_F = \beta_0+\beta_1F_1+ \beta_2F_2+\beta_3F_3+\beta_4F_4+\beta_5F_5+\beta_6F_6+\beta_7 F_7+\beta_8F_8+\beta_9 F_9+\beta_{10}F_{10} + e \quad (3)$$

Where A_F =is the land allocated to farm forest, the dependent variables; F_1 = Age of household head (AGE) ; F_2 = Year of settlement (YEARSETT); F_3 = Education level of household head(EDUC); F_4 = Household land size(HHLSZ); F_5 = Non-farm income(NOFINC); F_6 = Farm forest income (FFINC); F_7 = Crop income (CROPINC); F_8 = Household density(HHDENSE); F_9 = Number of household employees(NOEMP); F_{10} = Distance to regional markets(DISTANCE; and e = Stochastic error term

1.5 Decision Estimation Procedure

The household decision to expand farm forest activities is best reflected by productivity investments and outputs. However, these two factors are difficult to measure in cross-sectional data but land allocation can be used as the best alternative. Households are assumed to control land allocation to various uses and can best reflect the decision to expand or contract specific land use activity. Thus the amount of land under farm forest in the surveyed household is taken as the dependent variable. All incomes entered into equation 3 are gross incomes from agricultural and forest outputs sold by the household inclusive of production costs due to great variation in technology use and productivity among farms in the region. It is assumed that higher gross incomes generate higher net incomes under similar technologies and biophysical conditions.

The selected factors were tested for their influence on household's farm forest land use decisions in the region using a Cobb Douglas type of production model. The expected influence of each factor on farm forest land use is hereby briefly discussed.

1.5.1 Household Land size

In general terms there is inverse relationship between land size and intensity for smallholder farms due to limiting factors of production (capital and labour). However, in relation to farm forest, when land is very small in size and is in critical shortage supply land size may have positive influence. Thus farm forest intensity increases with decreased land ownership as a response to both intra household product demand and need for increased productivity.

1.5.2 Age of household head

The study presumes that young farmers may be more inclined to invest in short rotation and high yielding crop production due high expenditure outlay they face than investing in farm forestry as compared to their older farmers who may have less cost outlay demands. Also older farmers have had longer period to acquire skills, make informed choices and adopt visible forestland use pattern. Farm forest choice may become attractive with reduced level of physical activity that comes with old age coupled with its high returns to labour inputs. In Vihiga County it was reported that farmers tend to grow trees on farms as a security for large cost outlays demand such as university fees and thus the relationship between farm forestry and age is expected to be positive.

1.5.3 Education level of household head

Education is an important factor that influence land use decision making, more educated household heads are better placed to acquire more information on farming. They are expected to be more innovative than uneducated counterparts. Depending on land use objectives, more educated farmers are expected to invest in commercial farm forests where such land use is competitive to alternative land uses than otherwise. Also their perception of environmental values may make them invest in farm forests due to high rating of environmental values. This is a perverse relationship that may vary across the households depending on prevailing factors. However, a positive relation is presumed.

1.5.4 Cultural factors

Tree planting in Vihiga has a long history and shortage of tree products is well perceived and thus self-sufficiency is more enshrined in the minds of the household members than in Uasin Gishu. The importance of trees in Vihiga is manifested by such factors requirements that newly married couples plant trees for their future use and prevalence conflicts related to tree ownership and use. The unique cultural attachment to trees between the two counties can be traced to the history of tree planting, population density and species dominance. Therefore, since there are differences in these key factors between the two counties, farm forest activities are expected to structurally differ as reflected by the intercept and slope.

1.5.5 Farm forestry incomes

High incomes from farm forest reflect high demand for forest products and classic economic theory expect rational households to expand supply through investment in production by putting more land into farm forest use. This is a price response approach that is based on household expectation on high returns to farm forest activity thus accelerating incentive for expansion of tree planting.

1.5.6 Distance to regional markets

Regional markets because of high population density, presence artisanal industries (carpentry), fuelwood consuming industries, high demand for woodfuel and construction activities creates markets for farm products. It is expected that households nearer to urban markets over time have developed structural capability to produce roundwood products to meet the demands of these consumers. Market information, pricing and bargaining skills is more developed in the market neighbourhood than distant rural farms. Also the transaction costs are higher for distant producers than those close to the markets. These factors favour producers nearer to the market than those far away and farm forest development is expected to be greater in areas nearer to key market outlets. Farm forest development is presumed to be negatively correlated to distance from regional markets.

1.5.7 Farm employees

Presuming agricultural activities demands high labour inputs and therefore forest activities are likely to be expanded under conditions of higher labour availability than otherwise. This is because more on-farm employees makes it more likely that some labour hours will be available for tree planting operations such as nursery, digging holes, planting, thinning and prunning during lax seasons. Positive relationship is postulated.

1.5.8 Household density

In the absence of off-farm incomes, it is presumed that decrease in per capita land holding will impoverish land dependent households by diminishing their ability to generate subsistence material needs and surplus outputs for sale. The condition as well diminishes their capacity to generate income for purchase of various materials and services the household cannot produce or provide. Therefore households are presumed to respond by adopting more land uses to produce wider range of products from their smallholdings. Therefore increased intra and inter household demand for forest products with increased persons per unit household land make household to plant more trees on their farms. Increased population also increases demand for forestry products and thus emergence of farm forest product markets and commercial oriented tree growing hence positive relationship. Contemporaneously, increased household size at initial stages induces clearing of natural vegetation to create

room for agricultural activities, settlement and intensive tree planting.

1.5.9 Years of settlement

Several factors comes into play with years of settlement such as increased household size, skills in tree planting, decreasing land size due to subdivision and ageing of land owners which as discussed above favour increased tree planting activities.

1.5.10 Crop incomes

Higher incomes from crop activities makes farmers increase land under such crop and as well its intensive management at the expense of other land use to include forestry. Since farm forests compete with crops for input and factor resources mostly land and labour and as well compete spatially for water and sunlight when planted in close proximity especially under reduced landholdings, clearing of trees to increase cropland and productivity becomes inevitable. Therefore the assumption is unless, otherwise, intensive commercial agricultural activities are negatively related to tree planting activities.

2.0 Integrated Land Use Decision Results

2.1 Data sources and transformation.

Farm level data used in generating multiple regression outputs of household's farm forestry land use determinants are cross-sectional data that only provide a snapshot of the charcateristics. Cross-sectional data are fraud with high variability for several reasons such wealth endowment, social characteristics and land use objectives among other factors. Cross-sectional data have necessary recipe for both multicollinearity and heteroscedasticity traced to data collection, model specification, dissimilarities in household wealth generating assets and productivity (Gujarati, 1995). Due to the nature of the household data most of which are related to land size and income sources, correlation among its variables is inevitable and transformation and reduction of correlated variables to reduce heteroscedaticity was done.

2.2 Results of integrated land use decisions

Several transformations were done to the data, lin-log yielded the best results as most variables assumed hypothesized signs and few were statistically significant. Tests to evaluate structural differences between farm forest activities in Uasin Gishu and Vihiga households in relation to selected farm forestry determinants was done through use of dummy variable regression model.

Several socio-economic variables postulated had mixed results at 10% significance level. Table 1 shows that out of 10 variables, 3 variables were significant at 10% significance level in Vihiga; on farm income (NOFINC, $\rho_{9,185}<0.01$), household land size(HHLSZ;$\rho_{9,185}<0.005$) and farm forestry income(FFINC,$\rho_{9,185}<0.000$). For Uasin Gishu two variables were significant, household land size (HHLSZ,$\rho_{9,185}<0.01$) and farm forestry income (FFINC;$\rho_{9,185}<0.000$). The combined results show that 5 out of 11 variables were significant non-farm income (NOFINC, $\rho_{9,185}<0.005$) crop income (CROPINC,$\rho_{9,185}<0.005$); household land size (HHLSZ;$\rho_{9,185}<0.05$); farm forestry income (;$\rho_{9,185}<0.000$) and dummy variable (DV, $\rho_{10,185}<0.005$. The most stable explanatory variable for the three regressions were household land size and farm forestry incomes. This shows that they are the most important variables in farm forestry land use decisions in the region. The dummy variable significance is supported by descriptive statistics that revealed the significant mean differences in most key variables between the two districts as shown in Table 4.2. The negative sign of the dummy variable indicate the farm forestry in Vihiga is more intensive as compared to Usin Gishu that was taken as the reference or benchmark.

Most sociological variables had hypothesized signs but were not statistically significant indicating that they were not important in farm forestry land use decisions as per the methods applied. This suggests that most of these factors may only enhance land use decisions or their influence is absorbed by other critical variables.

The results enhance the priori expectations of farm forest incomes and land size as strong determinants of household farm forestry land use decision. Farm forest is largely labour intensive activity, monetary expenses such as for purchase of seedlings and hire of labour are the only visible monetary expenses but most households raise their own seedlings and use household labour. This partly explains why the impacts of farm employees on farm forestry decisions are not significant.

The marked differences between the two counties in some variables are due to various factors. Large holding and mono-cropping is more widespread in Uasin Gishu where mechanized maize and wheat farming is prevalent and tree planting is a peripheral land use mostly in homesteads and spaced avenue or boundary planting. The influence of recent roundwood harvests and sales from mature trees and commercial black wattle woodlots is strongly reflected in the importance of farm forest incomes. Contrary to compelling evidence that population density exert a significant pressure on farm forestry resources, the size and sign of household density show that it can have both negative and positive influence on farm forestry development. It is positive for Uasin Gishu whereas it is negative for both Vihiga and combined results. The results are in line with recent studies that have shown that whereas population and diversity of natural vegetation is lost due to population pressure and

increased land use intensity but tree planting on farms increases with increased population density. This is because decreased land sizes make farmers change their land use strategies and objectives towards subsistence farming where multiple cropping and diversity increases to include intensive tree planting not only as a self-sufficiency strategy but as well increase productivity value per unit area (Ukpolo, 1994). The number of fast growing species and land sizes set aside for tree growing increases due to demand/supply driven response for better productivity and quality of forest products and environmental values. This may be possible up to critical threshold when household needs for settlement and food security may tilt land use against farm forest, this may be the case in Vihiga where it shows negative elasticity though not significant. Most variables that influence farm forest land uses are related to population pressure on land resources and potential financial incomes from surplus products. Farm forest is stronger and more robust in Vihiga than Uasin Gishu because of the number of decisions variables that influence its adoption. Age of household head, education, number of employees and non-farm incomes are all positive but not significant which may mean that these factors though not critical in decisions to invest in farm forestry but do enhance decision process. Non-farm incomes may have a strong impact on crop production in general investment strategies. This is because non-farm income may substitute scarce credit in enabling purchase of production augmenting inputs necessary for intensive crop production. It as well reduces household seasonal income variance and thus enables trees to occupy larger areas without jeopardizing food security in land scarce areas such as Vihiga.

Table1: Unrestricted OLS Multiple Regression for Vihiga and Uasin Gishu: Dependent variable: Household Farm Forestry land size(HHFFLSZ)

Variable	Vihiga N=108	Uasin Gishu N=82	Combined N=182
	β	β	β
Constant	-2.72(-1.84)*	-9.382(-2.518)**	-0.576(-0.324)^{NS}
lnAGE	-0.122(-0.39)^{NS}	1.156(1.394)^{NS}	0.339(0.860)^{NS}
lnEDUC	0.116(0.96)^{NS}	0.462(1.020)^{NS}	0.018(0.786)^{NS}
lnYEARSETT	-0.005(-0.056)^{NS}	0.137(0.821)^{NS}	0.060(0.590)^{NS}
lnNOFINC	0.155(1.96)*	0.043(1.411)^{NS}	0.155(2.047)**
lnDMARKET	-0.053(-0.210)^{NS}	0.102(0.512)^{NS}	-0.266(-1.485)^{NS}
lnNFEMPL	0.058(1.22)^{NS}	0.0645(0.539)^{NS}	0.114(0.737)^{NS}
lnHHLSZ	0.603(2.157)**	0.881(1.999)**	0.181(2.289)**
lnCR0PINC	-0.022(-0.715)^{NS}	-0.122(-1.596)^{NS}	-0.022(-2.272)**
lnFFINC	0.151(4.78)***	0.163(3.480)***	0.0954(2.775)***
lnHHDENSE	-0.025(-0.094)^{NS}	0.343(0.758)^{NS}	-0.0652(0.209)^{NS}
Dummy Vihiga = 1)			(2.175)**
R	0.734	0.649	0.744
Adj R^2	0.497	0.349	0.519
F	20.565***	5.824***	15.830***

*** ($\rho_{9,108}$ <0.01** ($\rho_{9,108}$<0.05) *($\rho_{9,108}$<0.1) ^{NS}($\rho_{9,108}$>0.1

2.3 Conclusions and Recommendations

The integrated land use decision approach models showed that farm forestry investment decisions is influenced by several factors, most are largely as a result of demand and supply conditions in forms of household land size and incomes from on-farm activities. High population density increases the forest products subsistence needs of the households through intra and inter household demands. Households simultaneously respond by increasing land under tree crops and management intensity to increase the aggregated tree product supply. Falling household income opportunities has two effects that favour farm forestry expansion, increased subsistence needs and shortage of incomes to purchase tree products that they cannot produce on their own farms. Secondly, trees are grown as bank reserves that can be relied upon for stress related sales to cope with increased demand for cash to purchase off-farm goods and services.

Household land size has strong influence on land use decisions irrespective of household's production strategy whether it is skewed to subsistence or surplus for markets. Farm forest incomes are importance driving force in decisions to plant trees indicating household economic objectives on household land use decisions. This is true for commercial *Acacia mearnsii* woodlots for charcoal and bark production in Uasin Gishu and Eucalyptus woodlots commercial polewood production in Vihiga.

Therefore key factors that influence farm forest development need to be taken into consideration in the promotion of tree growing on farms for both subsistence and commercial purposes.

3.0 References

Arnold, J.E.M.(1997). Framing the Issues pp 3:11, *Farms, Trees and Farmers*: *Responses to agricultural Intensfication*, J.E. Michael Arnold and Peter A. Dewees (eds), Second Edition, London: Earthscan Publication Ltd.

Byron, Neil and Boutland annie(1987). ‘’Rethinkinhg private forestry in Australia’’ Australian Forestry.

Cheboiwo, J. K. (2015). A Review Farm Forestry Evolution for the last 100 years in Kenya: A look at some Key Phases and Driving Factors. A Paper Presented to 10th Forest Society of Kenya Policy Dialogue Conference Towards Achieving 10% Forest Cover: Is Agroforestry and Commercial Forestry the Answer? Held at Sai Rock Hotel, Mombasa 1-2 October, 2015.

Cheboiwo, J. K. and Ongugo, P. (1989). A Survey on Black wattle Growing by Farmers in Kenya. KEFRI Technical Paper No. 2, Nairobi Kenya.

Dewees, P. A. (1991). *Social and Economic Incentives for Smallholder Tree Growing. A case Study from Murang'a District, Kenya*. Forests, Trees, and People/FAO. Community Forestry Case Study Series No. 5.

Dewees, P. A. and N.C. Saxena (1997). *Wood Products as Incetives for farm tree growing: Farms, Trees and Farmers: Responses to agricultural Intensfication*, J.E. Michael Arnold and Peter A. Dewees (eds), Second Edition, London: Earthscan Publication Ltd.

Gasson, R. (1973). Goals and values of farmers, J. Agric, Econ.,24, 521-542.

Humphrey, N. (1947). The Liguru and Land: Sociological Aspects of some agricultural problems of North Kavirondo, Government Printers, Nairobi, Kenya.

Ikiara, M.M.(1999). Sustainability, Livelihood, Production and Efficient Supply in a Declining Fishing: The Case of Kenya’s Lake Victoria Fisheries. Ph.D Thesis, Faculty of Economics,University of Amsterdam, The Natherlands.

Janssen, M.A.; Walker,B.H. Langridge,J. and Abel, N. (2000). An adaptive agent model for analysing co-evolution of management and policies in a complex rangeland system, Ecological Modelling 131, 249-68, Elseview Science B.V.

Muchiri, N.M., Pukkala, T. And Milna, J. (2000). Optimizing the Management of Maize-Grevillea robusta on farms in Kenya, *Agroforestry Systems* 56: 13-15

Nyang, F.O(1999). *Household Energy Demand and Environmental Management* in Kenya, PhD Thesis, Faculty of Economics, University of Amsterdam, The Natherlands.

Patel, S. H., Pikney, T. C. and Jaeger, W.K. (1995). Smallholder wood production and population pressure in East Africa: Evidence of an Environmental Kuznets Curve? Land Economics 71(4) 516-530.

Stoll J.R.; White, F.C. Ziemer Rod, (1984). Differential assessment of agricultural lands in the South, Mississipi State, MS:Southern Rural Development Centre.52pp.

Tiffen, M. Mortimore, M. and Gichuki, F. (1994). More People Less Erosion, Environmental Recovery in Kenya ,Nairobi, Kenya ACTS Press.

Ukpolo, V. (1994). The link between poverty and environmental degradation in Sub-Saharan Africa in Environment and Economic Delemmas of Developing Countries: *Africa in the Twenty-First Century*, Valentine Udoh James (eds), London Praeger, pp. 69-80.

Warner, C. (1997). Patterns of tree growing by farmers in East Africa pp 90:110, *Farms, Trees and Farmers*: *Responses to agricultural Intensification*, J.E. Michael Arnold and Peter A. Dewees (eds), Second Edition, London: Earthscan Publication Ltd.