THE EFFECTS OF THE INTERNATIONAL SMALLGROUP AND TREE PLANTING PROGRAM ON HOUSEHOLD INCOME IN NYERI DISTRICT, KENYA

BY
EMMANUEL K. KINUTHIA

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DECLARATION AND RECOMMENDATION

DECLARATION

This thesis is my original work and has not been presented in this or any other university for the award of a degree.

Emmanuel K. Kinuthia

KM17/1866/07

Sign: 

Date: 03/10/2011

RECOMMENDATION

This work has been submitted with our approval as University supervisors.

Dr. G. Owuor (PhD)

Department of Agricultural Economics and Agribusiness Management, Egerton University.

Sign: ----------

Date: ----------

Dr. W. Nguyo (PhD)

Department of Agricultural Economics and Agribusiness Management, Egerton University.

Sign: ----------

Date: ----------

DEDICATION

This work is dedicated to my parents and siblings for their unmatched support.

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ABSTRACT

Household poverty and food insecurity in Kenya is a major challenge especially in rural areas. The situation has been exacerbated by poor economic performance, nationwide drought and the global financial crisis. Nevertheless, numerous efforts are being made both by the government and non-governmental organizations to mitigate the situation in rural areas notably in Nyeri district which is a relatively poor district in central province with poverty rate standing at 30% (CBS, 2008). Nyeri district has been a target of a non-governmental organization, The International Smallgroup and Tree Planting Program (TIST). Its objective is to help locals increase their income and conserve environment by planting trees. Farmers are increasingly joining the program substituting land previously allocated for food crops with tree planting enterprise. Despite presence of TIST, poverty still remains high in the region, with the statistics showing an increase in the population living below the poverty line from 29% in 2000 to 33% in 2006 (CBS, 2008). The main objective of the study was to determine the effects of TIST program on household income, environmental services and to determine factors that influence participation through a survey questionnaire. Multistage sampling was applied in selection of 120 farmers and analysis was done using SPSS and STATA. Heckman two stage sample selection model was used in analyzing factors that determine participation and log-log model was used to quantify the contribution of the program to household income upon participation. Descriptive statistics were used to determine the effects of the program on environmental services. The results showed no significant difference in income between participants and non-participants. Other socioeconomic and farm specific factors showed significant difference in household incomes. Farm sizes, access to micro-finance and program awareness positively influenced participation and were significant at 5% level of significance. Farm size p>(z) value was 0.048, access to micro finance(0.018) and program awareness(0.029). The program had a positive effect on a variety of environmental services. The study recommends that TIST program should adopt a better tree planting management approach to avoid total substitution of crops with tree planting enterprise and collaborate with the government and other stakeholders in linking farmers with market for their produce so as to enable them market their surplus and further research be done to explore issues that this study was not able to capture like technical issues regarding carbon sinking, the cost being presently incurred and potential benefits in the future and opportunity cost of the foregone agricultural output.

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ACRONYMS

TIST	-	The International Smallgroup and Tree Planting Program
CDM	-	Clean Development Mechanism
FAO	-	Food and Agriculture Organization of the United Nations
IFPRI	-	International Food Policy Research Institute
UNDP	-	United Nations Development Programme
CBS	-	Central Bureau of Statistics
GOK	-	Government of Kenya
GDP	-	Gross Domestic Product
USAID	-	United States Agency for International Development
GHG	-	Green House Gases
OECD	-	Organization for Economic Co-operation and Development
NGO	-	Non-Governmental Organization
IMR	-	Inverse Mills Ratio

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CHAPTER ONE: INTRODUCTION

1.1 Background information

In the last four decades, there has been a remarkable growth in agricultural production with per capita world production rising by 17% (FAO, 2004). Over the same period world population has grown twice but per capita agricultural production has overtaken population growth. Nevertheless, the situation is different in Africa where in the last decade progress in the drive to reduce hunger has been slow with Kenya recording a 33% under malnourished portion of its population in the period 2002-2003 (IFPRI, 2005). Kenya is rated among the most food insecure countries with about half the population living below poverty line (UNDP, 2004). Nevertheless, the overall absolute poverty level has declined from 52.2% in 1997 to about 46% in the year 2006 (CBS, 2008). Variations however do exist among the different regions in the country with some showing a significant reduction in poverty while others an increase.

The country is at a state of food shortage coupled with malnutrition, mainly attributed to the recent drought, slow growth in agriculture and overall poor economic performance. Agriculture is of paramount importance in our economy, employing 80% of rural population and contributing about 25% of the GDP (CBS, 2008). This implies that agriculture improvement can significantly reduce poverty. The high dependence of a large proportion of Kenyan population that derives its livelihood from land and natural resource based production system has led to environmental degradation. Conservation and sustainable use of resources should be an integral part of national planning and poverty reduction efforts.

Climate change and the associated negative effects towards agriculture is a global concern with the worst negative effects being experienced in the developing world (Brown *et al.*, 2001). Among the serious challenges facing countries today is reconciling the need to reduce poverty and increase productivity while in the meantime protecting natural resources given the recent decision to include small-scale projects implemented by low income communities in the Clean Development Mechanisms of the Kyoto Protocol. Under this protocol, industrialized countries with emissions targets can implement tree planting projects that reduce emissions in developing and transition countries (Streck and Scholz, 2006). Various observers have already noted that economic and technical matters are of real concern with less attention being paid to issues of

equity and sustainable development. Yet the most basic understanding of the nature of these projects reveals that the issues are of utmost importance since projects take place in rural areas where majority of poor people are concentrated and competition for land among the alternative agricultural uses is evident and livelihood conditions are fragile and complex.

The government has made numerous attempts to ensure food security and poverty alleviation efforts are not compromised by the worsening climatic conditions where the strategy for revitalization of agriculture 2004-2014 was established with the government taking facilitative role and the private sector taking the lead to further support the efforts of the 2001-2004 Poverty Reduction Strategy Paper. Agriculture and rural development received the highest priority. To improve environmental management, the government committed itself together with other stakeholders to create awareness on environmental cost and benefits and involve communities in environmental conservation activities such as reforestation (G.o.K, 2003). To ensure proper natural resource management, sustainable agriculture is among the practices that have to be implemented to be in line with Clean Development Mechanism.

Among the various stakeholders that are closely working with the government to ensure this is implemented is The International Small group and Tree planting Program (TIST). It is a non-governmental organization which operates in Kenya, Uganda, Tanzania and India. It was started at Mpwapwa in Tanzania and spread to the rest with the financiers of the program being Dow Foundation and Clean Air Action. The program is voluntary and works with small groups of between 6 to 12 people who want to improve their lives and local environment by planting trees and practicing sustainable agriculture. The farmers own the trees and keep the fruits and other benefits. Farmers also receive Ksh1500 annualy for every 1000 live trees. All this is geared towards ensuring that low income communities benefit from CDM projects and improve their livelihoods. The program has been undertaking its work in Mt Kenya region in collaboration with USAID Kenya with the aims of ensuring farmers practice sustainable agriculture, improve food security and incomes. The program helps farmers to get training on nursery development, conservation farming and sustainable development best practices, HIV/AIDS education and care and business skills.

Each small group must plant a minimum of 1000 trees each year and practice conservation farming. They also sign a contract that transfers the carbon credits earned and work together to develop, adopt, report and share with other small groups best practices in all the areas in their lives such health and economic activities. The program has two main components; the first is the greenhouse gas component. This is managed and funded by Clean Air Action Corporation which markets the carbon credits. The second component which was the main focus of this study is sustainable development managed by the Institute for Environmental Innovation, this offer training to farmers on improved methods of cultivation as well as business skills.

1.2 Statement of the Problem

TIST program was commissioned in the year 2004 with several objectives: to increase households' income and reduce poverty, improve nutrition and health, increase productivity through sound agricultural practices and also play part in carbon reduction from the atmosphere. More farmers are increasingly joining the program whereby the end of year 2007 the registered number was more than thrice the target (TIST, 2008). Despite presence of TIST, households' incomes remain low as indicated by high poverty level in the district, with the statistics showing an increase in the percentage of the population living below poverty line in Nyeri district from 29% to 33% between the year 2000 and the year 2006 (CBS, 2008). The effect of the program on households' incomes and environmental services such as soil erosion, fertility, micro climate and property aesthetic value in the region is not yet known and factors that influence participation. The study focused on filling this information gap.

1.3 Objectives

The overall objective was to determine the effects of TIST program on households' incomes in Nyeri district.

The specific objectives include:

i. To determine the factors that influence farmers' participation and the acreage allocation in TIST program.

ii. To establish effects of TIST on soil erosion, fertility, micro climate and property aesthetic value.

iii. To establish the effects of TIST program on household income.

1.4 Hypotheses

i. Socioeconomic, institutional and farm specific factors do not significantly influence participation and acreage allocation in TIST program.

ii. TIST has no significant effect on soil erosion, fertility, micro climate and property aesthetic value.

iii. TIST program has no significant effect on households' income.

1.5 Justification

A household becomes poor and food insecure when potential sources of income and food are threatened or strained. Planting of trees implies increased competition of scarce land, labour and capital between tree enterprises and other on-farm enterprises. Given that poverty is high, food insecurity is looming in the country and that the existing factors of production face further pressure. It was therefore vital to conduct an empirical study geared towards analyzing the factors that drive farmers towards participation in such a program to get a better understanding of the program's effects on household income. Many small-scale tree planting projects in Africa under CDM are fairly new with many initiated recently. Therefore, there are few studies on the impacts of these projects on host countries or project participants (Jindal *et al*, 2008). This creates an information gap which the study tried to fill especially on the effect household incomes, factors affecting participation and program effect towards environmental services. The empirical findings will serve to guide the policy makers and other stakeholders involved in such programs on appropriate interventions to support farmers improve their livelihood given that the program had a positive effect towards household incomes though not significant. The study will also be used by TIST to assess whether they have achieved their objective to increase household incomes which is key in determining sustainability of the program.

1.6 Scope and limitation

Technical issues relating carbon sinking were not explored. The study utilized cross-sectional data whereby income generated in year 2008 only was considered. Some information on sensitive variables such as household total income was not fully disclosed due to farmers' unwillingness to give out true information on income.

1.7 Definition of terms

Absolute Poverty: Condition whereby the average per adult income in a given household is less than 1 US$ per day.

Carbon sinking: A process whereby plants absorb carbon dioxide from the atmosphere and store it in its vegetative parts. Carbon is kept out of the atmosphere and thus does not contribute to the rise of atmospheric green house gas concentrations.

Farm income: Income generated from farming activity by an individual.

Food Security: State when all people at all times have both physical and economic access to sufficient food to meet their dietary needs for a productive and healthy life (USAID, 1995).

Household: A group of people bound together by ties, kinship or joint financial decision, who may live together under a single roof or compound, are answerable to one person as the head and share same eating arrangements.

Participation: Practice whereby a farmer engages in tree planting enterprise to improve the environment.

Smallholder: Households who own land and cultivate on up to a maximum of eight acres.

CHAPTER TWO: LITERATURE REVIEW

2.1 Household Income and Food Security

Temporary food insecurity is brought about by short term fluctuations in production and consumption resulting from fluctuation in household incomes and availability of food. Therefore temporary food insecurity is thus a manifestation of temporary lack of access to sufficient food (Obasanjo *et al.,* 1992).

Farm household is conceptualized as being endowed with a stock of resources termed as the household resource base (Jacoby, 1992). Vital among these resources is land which mainly determines households output, but also most households access food by consuming what they produce or by purchasing food in the growing season from income earned from their harvest time sales or from off farm work (Maxwell *et al.*, 1992). Therefore, farmers are expected to generate income from the sale of their produce which can be used to purchase food besides consuming what they produce from any farming activity. Income generated can also be used to serve as capital to diversify. Food security indicators include process and outcome indicators while the former describes food supply and food access the latter describes consumption habits. Households are better-off when they consume a wider variety of foods (Hoddinott, 1999).

2.2 Tree Planting Program and Households' income

Body of literature has been developed that assess the technological basis for, and potential magnitude of storing or sinking carbon in trees or agricultural soils. By sinking carbon in trees or other sinks, carbon is kept out of the atmosphere and thus does not contribute to the rise of atmospheric green house gas concentrations. The Cost-effectiveness of sinks, in conjunction with specific characteristics of policies to reduce greenhouse gas (GHG) emissions will ultimately determine the degree to which sinks are utilized in the overall portfolio of climate mitigation strategies. Various policy instruments are being implemented or are under study. While some countries like Italy and Sweden have adopted carbon credits or related taxes, emissions trading is the instrument being most intensively discussed and has been proposed in a number of countries that have ratified the Kyoto protocol where Kenya stands to be a beneficiary. This is seen in the implementation of tree planting program in Nyeri District. If taxes or standards were adopted for controlling the emissions of GHG's from sources, then carbon sinks in agriculture or forestry

could be used to implement the overall GHG reduction goal. While a lower mitigation obligation could also be applied to a trading system, there would also be the opportunity to include contributions to carbon sinks directly. For example, a farmer who adopts a tree planting enterprise that sequesters carbon could be credited with an emission reduction and could then sell that credit directly in the emissions market (Feng and Kling, 2004). Nevertheless, empirical analysis of the same in terms of the forgone food production was not covered posing issue of sustainability of such an enterprise in developing world as their main emphasis was on retired agricultural land in developed countries.

With emission crediting, developing countries could attract larger amounts of foreign direct investment which is the dominant long-term source of capital flow to developing countries with a net volume of 185 bn. USD in 1999. This accelerates overall economic growth as the most potent tool for poverty alleviation in developing countries (World Bank, 2001). Among the developing countries, especially African countries excluding South Africa failed to attract inward foreign investment in recent decades, even though gross returns on investment have been very high. The reasons are the significant risks of capital losses, most importantly macroeconomic instability, loss of assets due to the non-enforceability of contract, and physical destruction caused by armed conflicts (OECD, 2002)

2.3 Tree Planting Programs and Environmental Services

Forests and agro-forest systems produce a variety of global environmental services, including carbon sequestration and biodiversity conservation as well as provision of food and other wood products which can be marketed to earn income. Without payments for these services, land uses that include forests might not be attractive for private owners. This is certainly true in the tropics, where crops and pasture have been expanded at the expense of forests and food security is a priority among the smallholders (FAO, 2001). Profit-maximizing producers will enter into contracts to plant trees when the benefits for the contracts outweigh the opportunity cost. They will do this if the expected net return from their current operation is lower than the benefits to be achieved from the exercise, (Antle and Mooney 2002; Antle *et al.,* 2003). This is expected from a rational farmer.

Farmers who benefit most from adoption of tree planting enterprise have low opportunity cost of adoption and are the resource poor. Opportunity cost may decrease with time as carbon accumulates and productivity increases (Antle, 2005). Increased carbon sequestration has potential of increasing households' income and checking food insecurity in rural areas from a study done at Machakos Kenya (Antle, 2005). The study was conducted in a semi arid area and this study was done in a semi arid area but the findings showed positive relationship though not significant.

Many tree planting programs meant for carbon sinking in Africa are fairly new, with many initiated recently. Therefore, there are few studies on the impacts of these projects on host countries or project participants (Jindal *et al*, 2008). The paper therefore tried to address this by looking into the effects on participants' livelihood. Log-log model was adopted in evaluating the program effects on participants' income. To determine factors that affect participation, many studies have mainly applied logistic model (Jera and Ajayi, 2008), (Iqbal *et al*, 2006). According to Heckman (1979) this could lead to selection bias problem (Madala, 1983). This study therefore applied Heckman sample selection model to address the problem. Inclusion of microfinance in the program model could be among the factors that influence farmer participation which has not been captured by previous studies. This study considered this factor in analysis of determinants of participation. Further, extent of participation in terms of proportion of total land allocated to tree enterprise was analyzed.

2.4 Food Security Situation in Kenya

Land is the main asset in agricultural production and generally, limited availability of productive land is a major constraint to increased agricultural production. Kenya has an area of about 587,000 square kilometers of which 11,000 and 576,000 square kilometers are water and land mass respectively. Only about 16% of the latter is of high and medium agricultural potential largely because it receives adequate and reliable rainfall. The main feature of Kenya's agriculture is domination of small-scale farmers who account for 75% of total agricultural production and 70% of maize, 65% of coffee, 50% of tea, 90% of sugar, 80% of milk, 85% of fish and 70% of beef and related products. Production is carried out on small land holdings averaging 2-3 hectares mainly for both dairy and beef subsistence and commercial purposes.

(G.o.K, 2003). Major food crops in Kenya include wheat, maize, rice. Others include root tubers, sorghum, millet etc.

Many of the Kenyan households spend a considerable portion of their income on foodstuffs. On average 54% of households spend their total incomes on food with 27% of the food budget in the rural households being spent on maize grain and flour. Total annual on farm food crops production has lagged behind consumption resulting in food deficit and preventing achievement of food security and poverty alleviation. Study by Marinda (2005) shows that only Central province stands out as the only province with the lowest absolute poverty standing at 30%. Nevertheless, the drought that has hit the country between 2008 and 2009, and the financial crisis may have worsened the situation. The causes of poverty and food insecurity in Kenya include low agricultural productivity, inadequate access to productive assets that is land and capital, inadequate infrastructure, limited well functioning markets, high population pressure on land, inadequate access to appropriate technologies by farmers, effects of global trade and slow reform process (Marinda, 2005)

2.5 Measures to Alleviate Poverty and Achieve Food Security

Kenya Special Program for Food Security (KSPFS) was developed in the year 2002 where the Poverty Reduction Strategy Paper and the Kenya rural Development Strategy were used as the building blocks. It describes measures needed to alleviate poverty in the country. The food security program gives specific focus to the more than fifteen million absolute poor households living in rural areas primarily as farmers, pastoralists and fisher-folk. The program is working towards the food security needs of these people by encouraging and supporting farmers and community-based organizations in their efforts to improve agricultural productivity and other income generating activities.

In addressing food security issues in Kenya it is recognized that there are many extension service providers within the Government, NGOs, private sector, religious organizations and community based organizations where TIST falls. There are also many resources, human, physical and financial, held by these organizations. Through this program farmers are being empowered to identify their priorities and make demands on the service they need to solve their problems. The

extension service providers then work in a collaborative manner to respond to the farmers' demands.

2.6 TIST Program

The International Small Group and Tree Planting Program (TIST) operates in Kenya, Uganda, Tanzania and India. TIST has set up long-term contracts with participating farmers in Nyeri district whereby farmers receive Ksh 1500 per 1000 trees per year. Other benefits to farmers include access to fruits, minor timber, firewood and training on improved agriculture production as well as business skills. While such projects can potentially benefit poor households, they can also have adverse impacts according to Scurrah (2006). The analysis of program on effects of households' poverty assisted in bringing out the possible negative effects.

2.7.0 Theoretical Framework

Chaynov model on Russia peasants depicted that household represents a locus of economic activities. The interaction between the economics of the farm and the household was brought to light by Haddad (2000). The goals of the farm and its operation are linked to those of the household with the weight lying on income improvement to alleviate poverty and welfare improv ement. They include cushioning the household against future risks and uncertainties by capital ac cumulation and improving social status through wealth accumulation or by special technical, soci al and economic achievements (Marinda, 2005).

The main area of focus in this study was on household income improvement. With land being a constraint, productivity needs to be increased and this calls for sound resource allocation by the households so as to increase income and escape poverty trap. More so enterprise diversification can help to increase the household income and thus alleviate poverty. From the above, a farmer is expected to join the program if the expected returns will be higher than the present returns and if the risk involved is minimal.

2.7.1 Conceptual Framework

To ensure their physical survival, economic and social welfare, households engage in a range of economic activities which include on-farm, off-farm agricultural as well as non-agricultural activities. This can be seen in the continued engagement of farmers in the tree planting program in the region where the study was conducted.

From Ruthenberg model (1980), farmers consume part of what they produce or access food during off season from cash obtained from engaging in off-farm activities or savings from previous sales. The income can also be used to undertake diversification of enterprises and further increase incomes and boost food security. The conceptual framework shows how the various household socioeconomic and institutional factors which include education level of the household head, gender and age, household size, off farm engagement affect participation in the program. This in turn affects farm output which leads to income changes. These factors may also affect household's income directly. The change in income may eventually make more farmers to join the program or the existing farmers may increase the size of land allocated to tree planting enterprise and the end result is increased income contribution to a household. This in turn has a feedback effect to household socioeconomic factors where a household can increase off farm engagement. The income change also affects sustainability of the program and the farm specific factor whereby the household can increase the size of the land they own.

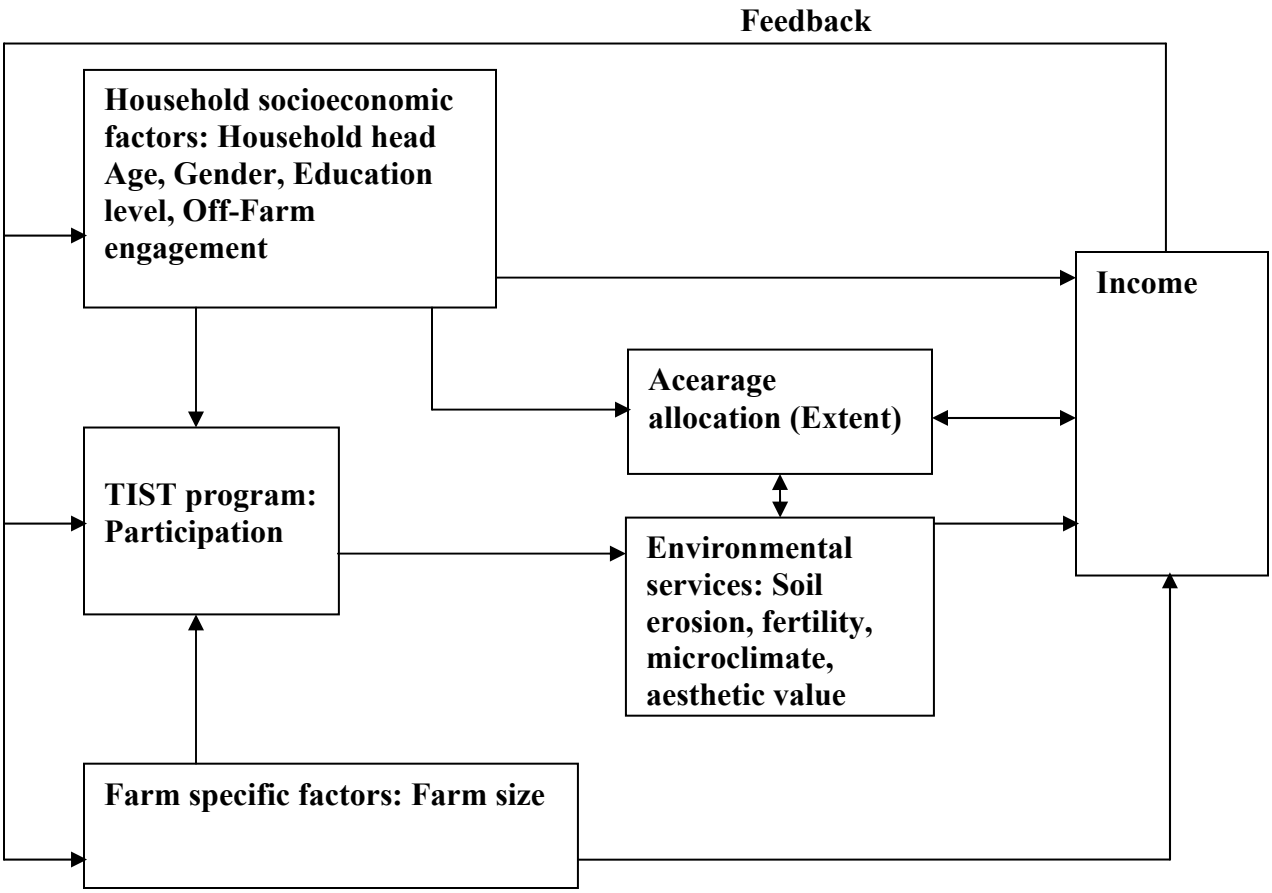

Figure 1: Conceptual framework
Source: Own

CHAPTER THREE: METHODOLOGY

3.1 Study Area

The program is undertaking its activities in Kieni East and Kieni West divisions of Nyeri district but the study was conducted in Kieni East division since it is where the program has been operational since year 2004. Nyeri district covers an area of 3284 km^2. Its main agro ecologic zones are coffee zone, cattle-sheep-barley zone and ranching zone which accounts for 16.4%, 15.6% and 11.8% of land use (Jaetzold *et al*, 2006). The size of high potential and medium-low potential agricultural land is 160000 hectares and 12000 hectares respectively.

Rainfall is bimodal with long rains being experienced from March to May and short rains from October to December. It ranges between 700mm to 2200mm. The population predominantly depends on agriculture with over 67% deriving their livelihood from agriculture. Livelihoods are also dominated by small-scale subsistence farming. Kieni East division is generally semiarid with the size of the agricultural land being 580 km^2. The available agricultural land per household is about 0.8 ha (Jaetzold *et al*, 2006). The current level of population living below poverty line stands at 30% (CBS, 2008). The map of the study area is as shown in Figure 2.

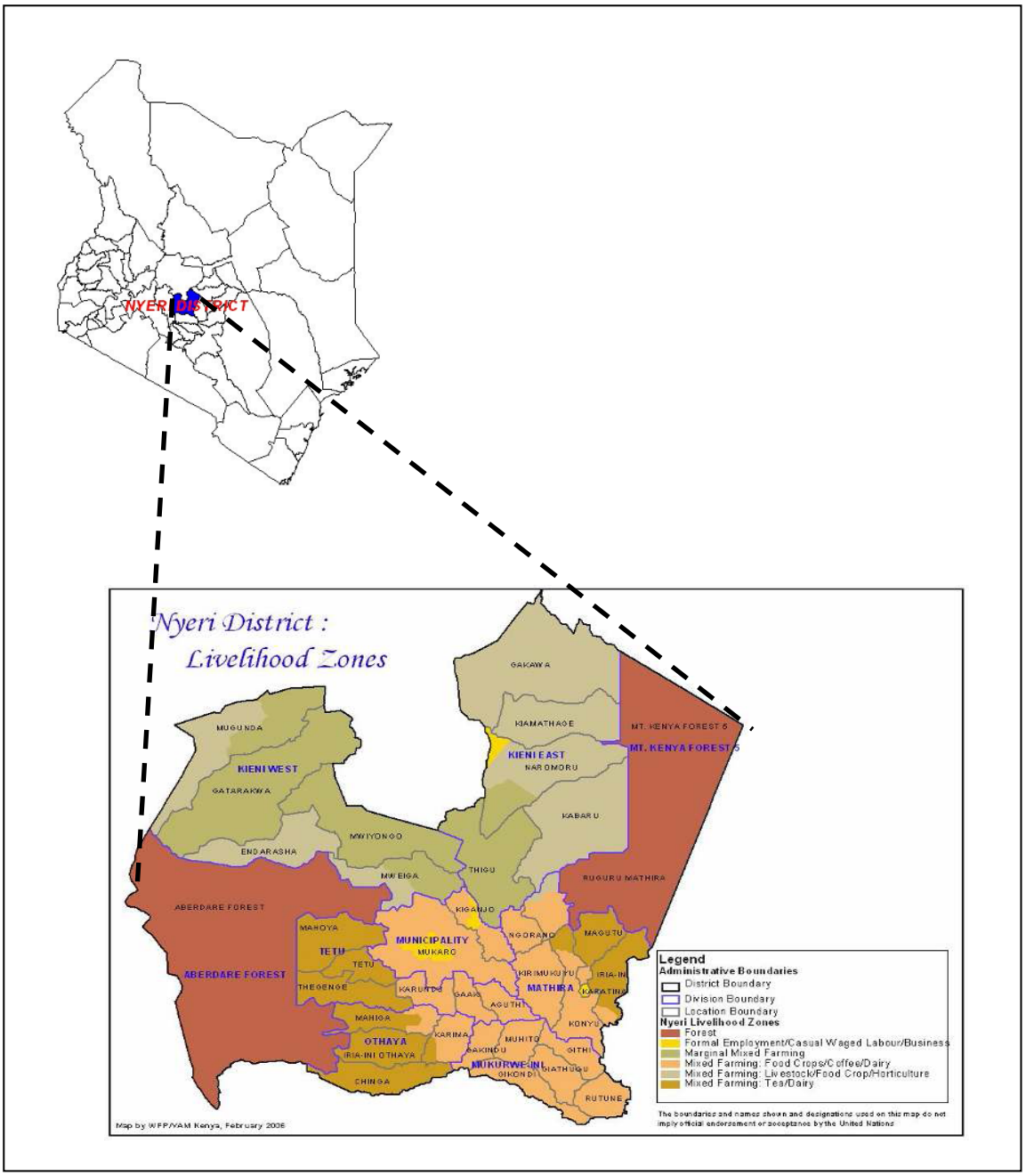

Figure 2: Map of Nyeri District

Source: Drought monthly bulletin. (G.o.K, 2007)

3.2 Sampling Design

Small scale farmers participating in the program and non participants made the target population of the study. This implies that a treatment and control approach was applied. A sample size of 120 was used as calculated using the proportion sample size determination formula as given by Anderson et al, (2007). Sixty participants and sixty nonparticipants.

$$n = \frac{(Z_{\alpha/2})^2 \overset{*}{P}(1-\overset{*}{P})}{E^2}$$

Population of smallholders in Nyeri district *(N)* = 87831

Number of participants (n) =6000

Proportion (P^*) $\frac{6000}{87831} = 0.0683$

Desired margin of error (E) = 0.064

Confidence level (coefficient) = 95%

$$n = \frac{(1.96)^2 0.0683(1-0.0683)}{0.064^2}$$

n is therefore 60 farmers.

Multistage sampling technique was used where Kieni East division was purposively selected, since it is where the program has been undertaking its activities since year 2004. The locations were stratified into participants and non-participants. A source list from the program was used to get the sample of participants from each location whereby systematic random sampling was employed. Simple random sampling was employed to select nonparticipants through lottery method. Non-participating farmers in the same sub-locations with the participants were selected for comparison.

3.3 Data collection

Interview schedules and personal observation were employed in collecting the required primary data. This was done with the help of properly trained enumerators. Data on socioeconomic, institutional characteristics, farmers' perception, enterprises and income sources was collected.

3.4 Data analysis

Collected data was analyzed using SPSS and Stata softwares. To achieve objective one, Heckman sample selection model was used to determine factors that influence participation and the size of land allocated to tree planting enterprise (extent). Many studies have mainly applied logistic model to determine factors that affect participation (Jera and Ajayi, 2008), (Iqbal *et al.*, 2006). According to Heckman, 1979 this could lead to selection bias problem (Madala, 1983). The study applied Heckman sample selection method to address the problem. To achieve objective two, descriptive statistics were used to establish the effect of TIST on environmental services. To achieve objective three, a log-log model was used to determine the effects of TIST program on household income.

3.4.1 Heckman sample selection model

The choice to participate or be selected to participate in any program may not necessarily be random. Consequently, selection bias or selectivity bias may exist. In this respect because participation in TIST was based on selection of participants, there could be bias. Thus, Heckman two stage procedure was used to control possibility of selection bias problem. Often people that respond to a survey are self selected implying that they do not constitute a random sample of the general population. Further a farmer decision to participate or not is guided by the perceived utility that will be derived out of engagement in that activity. Utility maximization behavior of a farmer cannot be observed and therefore the decision made is assumed to represent their utility maximization behaviour. Heckman (1979) addresses the problem (Madala, 1983) and this approach was employed in this study.

There are two underlying assumptions; decision makers are faced by only two choices and any choice an individual takes depends on his or her characteristics. The decision to participate will

be formulated in two interrelated choices. First the decision is related to the choice to participate and if the decision to participate is positive, then the second decision is how many acres out of the total (proportion) will be allocated to tree planting enterprise. The second choice will come only if the first choice is positive.

In the analysis, a probit equation was specified for whether or not the household is participating (selection equation) and an OLS equation for determining the extent in terms of acreage allocation (outcome equation) as shown below.

Selection equation

$$I_i^* = w_i\alpha + \varepsilon_i \quad \text{.....1}$$

I_i =0 if $I_i^* \leq 0$

I_i = 1 if $I_i^* > 0$

Outcome equation

$$Y_i^* = X_i^{'}\beta + \mu_i \quad \textbf{.....2}$$

$Y_i = Y_i^*$ if $I_i = 1$ $\quad Y_i$ is not observed if $I_i = 0$

Y is only observed if some criterion defined with respect to ***I*** is met. The model has two stages; first a dichotomous variable ***I*** determines whether or not ***Y*** is observed, ***Y*** being observed only if ***I*** =1. Secondly we model the expected value of ***Y*** conditional on its being observed. So we observe ***I*** a dummy variable, which is a realization of unobserved continuous variable $\boldsymbol{I^*}$ having a normally distributed independent error ε with zero mean and a constant variance. For values ***I*** =1 we observe ***Y***, which is observed realization of a second dichotomous variable which has a normally distributed and independent error μ with a zero mean and constant variance. The two errors are assumed to have a correlation.

In the first equation, the dependent variable is binary and thus binary discrete choice modeling methodology was employed where a probit maximum likelihood estimator was used. In the second equation, the dependent variable (acreage proportion) is continuous and OLS was employed. In the first equation Inverse Mills Ratio (IMR) was calculated and used in the second equation as one of the independent variables. This is the correction term for the bias that arises from selectivity bias problem.

Model specification

Selection equation

$(\text{Participation})_i = \alpha_0 + \alpha_1(\text{age})_i + \alpha_2(\text{gender})_i + \alpha_3(\text{education level})_i + \alpha_4(\text{household size})_i + \alpha_5(\text{TIST Knowledge})_i + \alpha_6(\text{off-farm engagement})_i + \alpha_7(\text{access to transfers}) + \alpha_8(\text{access to microfinance})_i + \alpha_9(\text{farm size})_i + \alpha_{10}(\text{group membership})_i + \varepsilon_i$……3

Outcome equation

$(\text{Acreage allocation})_i = \alpha_0 + \alpha_1(\text{gender})_i + \alpha_2(\text{education level})_i + \alpha_3(\text{household size})_i + \alpha_4(\text{TIST Knowledge})_i + \alpha_5(\text{off-farm engagement})_i + \alpha_6(\text{farm size})_i + \alpha_7(\text{IMR})_i + \pi_i$……...……4

Table1: Socioeconomic and farm specific factors influencing participation in the program

Variable	Definition	Hypothesized effect
Household head education	Formal education in years	(+,-)
Age of household head	Decision maker's age in years	(+,-)
Off-farm engagement	Availability of off-farm engagement	(+,-)
Knowledge of TIST	Prior knowledge of TIST benefits (yes=1,no=0)	(+,-)
Gender of household head	If decision maker male or female(male=1,female=0)	(+,-)
Household size	Number of people in the family	(+,-)
Group membership	If household head belongs to a group (yes=1, no=0)	(+,-)
Access to transfer	If household have access to remittances(yes=1,no=0)	(+,-)
Access to microfinance	If household has access to microfinance (yes=1,no =0)	(+,-)
Farm size	Land size in acres	(+)

3.4.2 Descriptive statistics

Descriptive statistics were used to establish the effect of TIST on environmental services. Protection of soil from water and wind erosion, improvement of microclimate, improved soil fertility, improvement of water table and improved aesthetic value were the environmental services that were analyzed.

3.4.3 Multiple regression model

A Log-log model was used to determine effects of TIST program on household income. Apart from membership of the TIST program, there are other factors that influence households' income that can be included in the analysis (Owuor *et al* 2007). These include socioeconomic, farm specific and institutional factors that significantly contribute to income. The regressand was a continuous variable which makes it suitable for the model. The parameters can also be interpreted as elasticities. Further logs transformation allows estimation by OLS procedure where Log$Y$ is a linear function of logs of regressors X (Gujarati, 2003).

The model is specified as:

$$Log(Y) = \beta_o + \beta_1 log X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 X_4 + \beta_5 X_5 + \beta_6 X_6 + \beta_7 X_7 + \beta_8 X_8 + v \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

Y-Household income (Ksh)

β_i – Parameters to be estimated and *v* is the error term

X_1 - Household head education

X_2 - Off-farm engagement

X_3 - Gender

X_4 - Attendance of Agriculture training

X_5 - Ownership of title

X_6 - Access to transfers

X_7 - Membership of TIST

X_8 - Membership of another group

Table 2: Socioeconomic, institutional and farm specific factors influencing income

Variable	**Definition**	**Hypothesized effect**
Household head education	Formal education in years	(+)
Off-farm engagement	If the household head engages in off-farm activity (yes=1, no=0)	(+,-)
Gender	If decision maker is male or female(male=1,female=2)	(+,-)
Attendance of Agriculture training	If attended agricultural training (yes=1,no=0)	(+)
Ownership of title	If owns title to farmland (yes=1,no=0)	(+)
Access to transfers	If has access to transfers (yes=1,no=0)	(+)
Membership of TIST	If a member of TIST (yes=1,no=0)	(+,-)
Membership of another group	If a member of another group (yes=1,no=0)	(+)

CHAPTER FOUR: RESULTS AND DISCUSSIONS

4.1 Socioeconomic Characteristics of the respondents

The characteristics discussed include: gender, education level, age and occupation of the household heads. Other institutional characteristics such as group membership, land ownership and size as well as income sources were included.

4.1.1 Gender of respondents

Twenty-six percent of the respondents were female and 7 were male. This is shown in Table 3 below.

Table 3: Gender of Household head

	Frequency	Percent	Valid Percent	Cumulative Percent
Female	31	25.8	25.8	25.8
Male	89	74.2	74.2	100.0
Total	120	100.0	100.0	

Source: Survey data

These results portray that the sample contained a large percentage of male headed households. This could be explained by the fact that majority of households in Kenyan society are headed by males who are mainly the decision makers. A large portion of participants in the program; 75% are male while female only constitute 25%. The same case applies to nonparticipants where female headed households constitute 26%. This is shown in Table 4 below.

Table: 4 Gender in percentage

	Participants gender		Non participants gender	
	Count	Percentage	Count	Percentage
Female	15	25.0	16	26.7
Male	45	75.0	44	73.3
Total	60	100.0	60	100.0

Source: Survey data

Majority of farmers have attained primary and secondary education, with 31% of participants having completed primary school and 36% have completed secondary school. The same case applies to non-participants whereby 30% are seen to have completed primary school and 36% have completed secondary

school. However both groups contain a lower number of those without any form of education (10%) and those with tertiary level of education (10%). This is summarized in Table 5 below.

Table: 5 Education level in percentage

	Participants education level		Non participants education level	
Years	**Count**	**Percentage**	**Count**	**Percentage**
0	6	10.0	6	10.0
3	7	11.7	8	13.3
8	19	31.7	18	30.0
12	22	36.7	22	36.7
16	6	10.0	6	10.0
Total	60	100.0	60	100.0

Source: Survey data

4.1.2 Occupation of household head

A large portion of the respondents derive their livelihood from farming. This is depicted in table 6 below where participants who engage in farming constituted 66% and 50% of the non-participants also engage in farming as their primary activity. This implies that a majority of participants take farming as a means of generating income. With the business skills that they are equipped with, a larger portion is seen to engage in business (11%) as compared to the non-participants where only 8% own businesses. On the other hand, a slightly higher percentage of non-participants (15%) are employed outside agriculture while 6% of participants are employed outside agriculture as seen in Table 6 below.

Table: 6 Household head occupation in percentage

	Participants household head occupation		Nonparticipants household head occupation	
	Count	**Percentage**	**Count**	**Percentage**
Farming	40	66.7	30	50.0
Employed outside agriculture	4	6.7	9	15.0
Own business	7	11.7	5	8.3
Unemployed	3	5.0	6	10.0
Agriculture labourer	6	10.0	10	16.7
Total	60	100.0	60	100.0

Source: Survey data

4.1.3 Land size

Land is one of the most important factors of production in the country. The average land size was found to be less than two hectares. Seventy-six percent of non-participants had a land size of below four acres, while 65% of participants had land holdings below four acres. This is consistent with the findings of Jaetzold *et al* (2006). Further, only a small percentage had land holdings above ten acres in both groups with only 5% of non-participants having land above ten acres and 6% of participants having the same. Table 7 below shows a summary of land holdings in percentage.

Table: 7 Land size in percentage

	Grouped non participants land size		**Grouped participants land size**	
	Count	**Percentage**	**Count**	**Percentage**
0-4	46	76.7	39	65.0
5-9	11	18.3	17	28.3
10-14			2	3.3
15-19	2	3.3		
20-24			2	3.3
25-29	1	1.7		
Total	60	100.0	60	100.0

Source: Survey data

4.1.4 Age of household head

Age distribution of respondents is shown below. A majority of respondents, both participants and non-participants lie between 35 and 64 years. Thirty percent of participants lie between 35 and 44 years while 27% lie between 45 and 54 years. Twenty four percent lie between 55 and 64 years. However 24% of non-participants lie between 35 and 44 years, while 29% lie between 45 and 54 years. Twenty-two percent lie between 55 and 64 years. This shows that a large proportion of participants are relatively experienced farmers. This can be seen in Table 8 below which also shows a small percentage of farmers above 65 years.

Table: 8 Age in percentage

	Grouped participants age		Grouped nonparticipants age	
	Count	**Percentage**	**Count**	**Percentage**
25-34	4	6.8	7	12.1
35-44	18	30.5	14	24.1
45-54	16	27.1	17	29.3
55-64	15	25.4	13	22.4
65-74	4	6.8	4	6.9
75-84	2	3.4	3	5.2
Total	59	100.0	58	100.0

Source: Survey data

4.2.0 Heckman Maximum Likelihood estimates for factors that influence participation and extent of Participation

Heckman two-step model was applied to analyze the socioeconomic, farm-specific and institutional factors that determine participation and the extent of participation in the program. The results indicated that the model was appropriately specified with an overall chi-square of 29.81 that was significant at 1% level of significance (p>chi2= 0.003). Three of the variables were seen to be statistically significant given the low p values. They include program awareness, farm size and access to microfinance loan. The inverse mills ratio was also seen to be positive and significant implying that coefficients of the model were reliable and unbiased. This also supports the fact that there was a selection problem.

4.2.1 Selection Equation

The socioeconomic characteristics included gender of the household head, age, access to remittances household size, program awareness and the education level. Farm-specific factor was the farm size in acres. The institutional characteristics included group membership and microfinance loan access. Most of the variables were having expected signs. This is shown in Table 9 overleaf.

Table 9: Heckman sample selection model results of determinants of participation and extent

Variable	Coefficients	P>|z|
Step 2: OLS Estimate of Factors that influence extent of participation in TIST		
Education level (Years of Schooling)	-0.0032388	0.386
Program awareness (Yes=1,No=0)	0.1261681	0.000***
Off-farm engagement (Yes=1,No=0)	0.014891	0.688
Gender(Male=1,Female=0)	-0.335063	0.420
Household size (Number of people)	0.0007001	0.932
Farm size (Acres)	0.0083857	0.048**
Step 1: Maximum likelihood estimates for Factors that influence participation in TIST		
Gender (Male=1, female= 0)	0.012372	0.966
Household size (Number of people)	-0.0265846	0.704
Age of household head (Years)	-0.0055203	0.551
Off-farm engagement (Yes=1, No=0)	-0.1474806	0.569
Education level (Years of Schooling)	-0.0116588	0.643
Membership to other groups (Yes=1,No=0)	-0.2567482	0.357
Access to microfinance (Yes=1,No=0)	0.7033619	0.018**
Awareness of benefits (Yes=1, No=0)	0.5541298	0.029**
Farm size (Acres)	0.0335045	0.297
Access to transfers (Yes=1,No=0)	0.2311201	0.357
Wald chi2 (12)	29.81	
Prob > Chi2		0.003**
IMR		0.033**
N	116	

***Significant at 1%, ** 5% and * 10%.

Source: Survey data

Age of the household head had a negative sign, though not statistically significant. Being the final decision maker in terms of allocation of resources, the age of the household head plays an important role in determining whether to participate in tree planting or not. Age affected

participation negatively. This was found out to be the case in participation in fodder tree growing by Jera and Ajayi (2008). Younger farmers may be willing to try out new technologies, but older farmers may be unwilling to plant trees with no immediate long-term benefits. Dolisca *et al* (2006) found out that age had a negative influence towards participation in forestry.

Gender of the household also plays a role in determining the resource allocation. A negative relationship was obtained between household head gender and participation in tree planting. The same was found to be the case by Sofyan *et al* (1993). Research work on the adoption of coffee and cocoa in some African countries has shown that gender effects may be important (Appleton *et al.,* 1991). Households headed by females may find it more difficult to adopt a new enterprise if they have less easy access to resources and information than male-headed households. Women may also attach greater importance to nutrition than men do, this leads to a larger land being allocated to food crops relative to other enterprises. Collier *et al* (2002) also found out that female headed households had low participation rate in forestry activities.

Jera and Ajayi (2008), found a positive relationship between household size and participation in tree planting. This was contrary to the findings obtained whereby the relationship was found to be negative. This could be explained by the fact that the average agricultural land available per household is about 0.8 ha (Jaetzold *et al.*, 2006). Given the high and increasing population density, farmers are seen to give priority to food security and this in turn will serve to reduce probability of participation in tree planting enterprise given that the benefits will not be immediate and the risks and uncertainties involved in such enterprise are high. Trees could also be seen to be a hindrance to agricultural development and production more so in high potential areas. This could be due to competition with food crops and livestock for the scarce resources. The higher the consumption pressure a family faces due to size of the household, the lesser will be the probability of engaging in tree planting. The variable nevertheless was not found to be statistically significant.

The influence of education on participation in agro forestry activities has been seen to be positive (Owuba *et al.*, 2001). In this study, the results were contrary to this; this could be explained by the rationality of the farmers. Given that the region is a high potential area with export

horticulture being one of the major enterprises. Farmers with a higher level of education would tend to avoid tree planting to reduce competition for the available scarce resources. The opportunity cost would also be high if the land is put under tree planting. Further, returns from the enterprise are not immediate and the future cannot be predicted with certainty. This reduces the probability of farmers with higher education level to participate given that they have more information access than those with lower level of education. It was also found out that farmers with higher level of education had higher income than their counterparts with lower level of education. This could also serve to explain the lower probability of participation. Due to higher incomes, these farmers can easily access output enhancing inputs and diversify enterprises. Land parcels in the region are small and this implies that enterprises with higher returns will be accorded first priority. Further, formal education does not necessarily focus on benefits of tree planting as opposed to knowledge that farmers acquire as members of the tree planting program which is important in affecting decision making process.

Tree planting is a labour intensive and time consuming activity. Involvement in collective action meant for other activities will call for creation of extra time off the farm. This creates competition for time resource. Group membership therefore was seen to have a negative sign. This implies that involvement in other groups' activities reduces probability of participation in tree planting.

Farmers with off-farm income are less risk averse than those without sources of off-farm income (Herath and Takeya ,2003). However, off-farm activities compete for management resources available for adoption process with new enterprises. With majority of the rural small-scale farmers depending on family labour for their farming, availability of off-farm activities will have a negative effect towards engagement in another on-farm activity. Dimara and Skurass (1998) found out that an increase in the off-farm manual work units, decreased the probability of adopting flue-cured tobacco varieties in Greece. However, the relationship was not statistically significant. Similar findings were obtained from this study. The relationship between off-farm engagement and participation in tree planting was found to be negative, though not statistically significant. This occurs due to competition for labour between the two. Therefore farmers with off-farm engagement were seen to have a lower likelihood of engaging in tree planting.

Awareness of the program benefits was one of the socioeconomic factors that were found to be statistically significant. The coefficient was 0.5541 and p>z value of 0.029 and this is significant at 5% level of significance. Availability of information about the benefits of the program and how it works, places farmers in a better position regarding decision making in enterprise choice. Farmers with better knowledge on the short-term and long-term benefits from tree planting will have a higher probability of participating in the program than those without the information. Herath and Takeya (2003) found out that farmers with outside information had a higher probability of making a positive decision. Jera and Ajayi (2008), found out that farmers who have received information on tree benefits, have a higher probability of adoption of this enterprise.

Collier et al (2002), found out that farmers with better information regarding afforestation were better positioned to engage in planting trees in their land parcels. While improving the flow information to a decision maker is a necessary condition, it does not always increase their capacity to act on it (Dolisca *et al*, 2006). Resource poor farmers with limited access to tree seedlings and technical knowledge on raising trees even with prior knowledge of future benefits, may not engage in this enterprise due to lack of resources. Nevertheless, this problem is taken care of by the program as they offer both information and material support as well as an incentive for raising trees.

Access to microfinance loan was an institutional factor that was found to be statistically significant and positively influencing participation. The program model incorporates a microfinance project whereby farmers can access loans to meet their daily needs. This could act as an incentive given the fact that rural farmers have limited access to finance. Availability of loan upon participation in the program therefore leads to increased probability of participation. This is supported by the fact that prior knowledge of the benefits of participation, access of microfinance loan being one, increases the probability of participation.

Remittances availability was also another factor that had a positive influence towards participation though not statistically significant. This is due to income diversification because

most of the households access remittances from close relatives or children. This implies that the level of dependence is low as children have already been employed. The decision maker can engage in other enterprises as there is little consumption pressure that is being exerted on the existing factors of production especially land.

Farm specific factor included farm size though not statistically significant, it had a positive relationship. This implies that as the size of the farm increases, the probability of participation in tree planting enterprise increases. The same findings were obtained by Jera and Ajayi (2008), whereby farmers with larger parcels of land had a higher probability of adopting agro-forestry. Large farm size implies that the farmer can set aside a portion of his land to grow trees. Collier *et al* (2002), also found out that the more the land parcels a farmer was having, the higher the probability of participation in forestry. This further supports the findings of the study.

4.2.2 Outcome Equation

After analyzing the decision to participate in the program, the second equation analyses the extent of participation decision. In this case it is given as the proportion of total land that is allocated to tree planting. The Inverse Mills Ratio estimated from the first equation was added to the second equation as an independent variable so as to capture the selection bias effect. It also brings consistency in estimation of the remaining coefficients of the equation (Dolton and Makepeace, 1986). The variable was found to be statistically significant at 5% level of confidence justifying existence of selection problem and the use of the model.

Farm size was one of the variables that were found to be statistically significant. As the size of the land increases, the acreage allocation to tree planting increases. Farmers with large farm size will spare larger portions of land to plant trees compared to their counterparts with small parcels of land. This is consistent with the findings of Collier *et al*, (2002) who found out that as parcels of land increases, more land will be allocated to tree planting.

Household size was seen to have a positive relationship. As the size increases, the extent of participation also increases. This could be explained by the fact that it determines the supply of labour. During planting and taking care of trees thereafter, availability of household labour may enhance extent of participation. Households with less labour supply will allocate smaller portions

of land to tree planting than those with abundant labour due to competition of this resource among the enterprises.

Like in adoption, household headed by females allocate less land to tree planting than those headed by males. Women will give first preference to nutritional needs than men. Implying therefore, with land resource being a constraint, women will allocate less of their land to tree planting enterprise. This is consistence with the findings of Sofyan *et al* (1993) which showed that households headed by females are less likely to engage in tree planting as matters pertaining nutrition take the central role.

On the other hand, engagement in off-farm activities among the participants was found to have a positive relationship with the extent of participation. The role of off-farm engagement on allocation decision is not very clear (Herath and Takeya, 2003). Farmers with outside information are more likely to increase the area under tree enterprise. Also as off-farm activities increase, more land will be allocated to tree planting as competition for labour resource increases.

Program awareness was found to be statistically significant at 5% level of significance. Farmers with better knowledge of tree benefits will allocate more acres of land to tree planting than those with inadequate information. Farmers with adequate information are better positioned in making right decision regarding the size of land to be allocated to tree planting. This is consistent with findings of Collier *et al* (2002), which indicated that farmers with better information on benefits of afforestation program had a higher probability of allocating more land parcels to trees than those without adequate information.

Education was found to have a negative effect towards extent of participation, though not statistically significant. Although it places a farmer in a better position in terms of information access, the negative relationship could be explained by the fact that educated farmers might be less willing to substitute land used for agricultural production with tree planting. The opportunity cost may also be high given that the area is a high potential area where export horticulture is among the enterprises the farmers engages in. The significance of the Inverse Mills Ratio in the

second equation implies that use of Heckman sample selection model was appropriate in this study. In the first equation valuable information would have been lost and second equation would have given us biased results.

4.3.0 Descriptive Statistics for the effects of TIST on Environmental Services

The study used descriptive statistics to establish whether there is any significance difference between farmers' perception on the effects of TIST on environment. Environmental aspects that were analyzed include: protection of soil from water and wind erosion, improvement of microclimate, improved soil fertility and improvement of property aesthetic value.

4.3.1 TIST effect on water and wind erosion

A Chi-Square test was used to determine whether there is significant difference in farmers' perception on the program's effect on erosion. The results showed that farmers perception differ significantly. This is seen in Table 10 below. The obtained Chi-Square statistic is 41.9 with the probability of obtaining a value greater than or equal to this being low as shown by Asymp. Sig. The perceptions of farmers differ significantly implying that the program has an effect on wind and water erosion. This is consistent with the findings of Scherr *et al* (2004) who found out that trees offer a variety of ecosystem services to farmers and key among them is reduced soil erosion and sedimentation leading to improved water quality. Farley *et al* (2005) also found out that annual runoff reduced by as much as 75% when grassland was converted to tree plantation. This shows that tree planting can have a significant effect on reduction of soil erosion.

Table 10: TIST effect on water and wind erosion

	Observed N	Expected N	Residual
No effect	6	19.7	-13.7
Low effect	10	19.7	-9.7
High effect	43	19.7	23.3
Total	59		

Table 11: Test Statistics

	TIST effect on water and wind erosion
Chi-Square(a)	41.932
Df	2
Asymp. Sig.	.000

Source: Survey data

4.3.2 TIST effect on micro-climate

To get the program's effect on microclimate, a Chi-Square test was conducted and the results showed that there was a significant difference in farmers' perception on the effect of TIST on microclimate. This is shown in Table 12 below whereby only 8 farmers felt that the program had no effect on the local microclimate. The obtained Chi-Square statistic was 32.2 and the low estimated probability of obtaining a value greater or equal to this if there is uniformity of perception showed that the perception of farmers differ significantly.

Table 12: TIST effect on microclimate

	Observed N	Expected N	Residual
No	8	30.0	-22.0
Yes	52	30.0	22.0
Total	60		

Table 13: Test Statistics

	TIST effect on microclimate
Chi-square(a)	32.267
Df	1
Asymp. Sig.	.000

Source: Survey data

4.3.3 TIST effect on soil fertility

To determine whether the program had an effect on soil fertility, farmers were asked whether they had experienced any effect on land productivity upon participation in the program. The results showed that there was a positive effect on soil fertility. This is seen in Table 14 whereby only four farmers felt that the program had no impact on soil fertility. This is consistent with the findings of Jindal *et al* (2006), who found out that establishment of appropriate shrubs and woody perennials and soil erosion control restore soil quality by increasing its organic content.

This enhances land productivity. The low significance shows that there is significant difference in farmers' perception on the effect of the program on soil fertility.

Table 14: TIST effect on soil fertility

	Observed N	Expected N	Residual
No effect	4	20.0	-16.0
Low effect	8	20.0	-12.0
High effect	48	20.0	28.0
Total	60		

Table 15: Test Statistics

	TIST effect on soil fertility
Chi-Square(a)	59.200
Df	2
Asymp. Sig.	.000

Source: Survey data

4.3.4 TIST effect on property aesthetic value

Trees can improve property's appearance making it more attractive to potential purchasers. To determine whether the program had any effect on improvement of property aesthetic value, a Chi-Square test was applied. The results showed that the program had a significant effect on beauty of the region. This can be seen from Table 16 below where only three farmers felt that the program had no effect on beautification of the region. The low significance value suggest that farmers' perception on the effect of the program on beauty of the region differ significantly

Table 16: TIST effect on beauty

	Observed N	Expected N	Residual
No	3	30.0	-27.0
Yes	57	30.0	27.0
Total	60		

Table 17: Test Statistics

	TIST effect on beauty
Chi-Square(a)	48.600
Df	1
Asymp. Sig.	.000

Source: Survey data

4.4.0 Log-Log Estimates for factors that influence changes in household income

Participation in the program together with socioeconomic, farm specific and Institutional factors that affect income was analyzed to determine their contribution to household income. Log-log model was used to determine this. All the variables showed expected signs and the model was significant, with an adjusted R squared value of 0.9692. This implies that the variables included explained over 96% of variation in the log of total household income. Seven of the variables were found to be statistically significant given the low p values. This is shown in Table 18 overleaf.

Table 18: Log-log model results of determinants of household incomes

Variable	Coefficients	P>|t|
Gender (Male=1 Female=0)	0.6053253	0.003**
Household Head Occupation (Farming=0 Employed=1)	0.2247173	0.000***
Access to transfers (Yes=1,No=0)	0.7561368	0.000***
Off-farm engagement (Yes=1, No=0)	0.3421191	0.066*
Group membership (Yes=1, No=0)	0.3432779	0.074*
Attendance to seminar (Yes=1,No=0)	0.2682095	0.212
TIST membership (Yes=1,No=0)	0.2735483	0.120
Title ownership (Yes=1,No=0)	0.5156902	0.015**
Education level (Years of Schooling)	2.633288	0.000***
R^2	0.9719	
Adj R^2	0.9692	
Prob < F	0.000***	
N	104	

***Significant at 1%, ** 5% and * 10%.

Source: Survey data

Factors such as gender with a coefficient of (0.6053) had a positive influence towards household income implying households headed by males had higher incomes than those headed by females. Household head occupation with a coefficient of (0.2247) also positively influenced income implying that household headed by individuals with employment had higher incomes than those who only relied on farming. Access to transfers with a coefficient of (0.7561) also had a positive effect towards household income with those accessing transfers having higher incomes than those without access to transfers. Off-farm engagement which in this case implied business engagement had a coefficient of (0.3421) and positively influenced income. Group membership had a positive coefficient of (0.3432) showing the important role played by collective action in explaining household incomes. Ownership to a title (0.05156) and education level (2.6332) also

influenced income significantly indicating that these factors were of great importance in explaining variations in incomes among the sampled households.

Gender plays a big role in household income determination. This is one of the variables that was found to be statistically significant at 1% level of significance implying that gender plays a big role in explaining household incomes. From the study, households headed by males had higher incomes than those headed by females. This is consistent with the findings of Owuor *et al* (2007) and Alemayehu *et al* (2005) who found that households headed by females had lower income levels than those headed by males. This is explained by the fact that majority of rural women in Africa have limited access to productive assets and this inhibits their ability to engage in production especially in high value crops. Women lack legal right to property and this makes them incapable of offering collaterals in credit markets which can serve to boost production by enabling them access to output enhancing inputs or meet their consumption expenditures. This implies that investment in new technologies by women is affected negatively and engagement in productive enterprises is inhibited thus low incomes.

Household occupation had a positive sign towards household income; this indicates that it contributes significantly to household incomes. Given seasonality of agricultural production, farmers with extra engagement are guaranteed a regular flow of income. As household heads move away from farming to having salaried employment, a regular flow of income is ensured which boosts household income during the low seasons in production.

Similarly, off-farm engagement which in this case implies engagement in business showed a positive relationship and was significant in contributing to household income. Like in salaried employment, it supplements agricultural income during off-peak season and ensures constant income during long production cycle that characterizes agricultural production. Farmers diversify into other non-farm investments to ensure they have additional income which may assist in consumption smoothing or engagement in productive investment. Therefore, compared to those without off-farm engagement, farmers who have off-farm engagement had a higher income than those without.

As compared to households that do not access remittances, those that had access had higher incomes. From the results, there is a positive relationship between access to transfers and households' income. This was seen to be significant in contribution to household income with households having additional income from close relatives or friends.

Group membership had a positive sign and was significant in contributing to household income. Individuals form groups to benefit from collective action which arises when people come together because of constraints and take joint action and decisions to accomplish an outcome (Kirsten and Vink 2005). Examples of collective action include activities that involve the interests or well-being of a group. Compared to those without groups, individuals with group membership majority of who were in microfinance and self-help groups had higher incomes than their counterparts who do not engage in any collective action. This is consistent with the findings of Kirsten and Vink (2005) who found out that collective action helps individuals overcome transaction costs, enhance market power and thus improve their incomes.

Agriculture seminars attendance was also seen to have a positive relationship with income. This implies that those who attend agriculture workshops had good exposure to improved production methods and are better placed in making better decisions regarding production and thus improving their income than those who do not attend seminars. Nevertheless, the variable was not statistically significant.

Though not statistically significant, participation in TIST showed a positive sign implying that membership leads to increased income. This is explained by the fact that participants had additional income from the program. Further participants are trained on better farming practices which lead to better output and improved incomes. This is consistent with the findings of Antle (2005) which indicated that such programs had a potential of improving farmers' income and boosting food security. Tipper (2002) also found out that if small land holders in developing countries engage in tree planting projects, they can increase their incomes and alleviate poverty. A study by Jindal (2004) on Nhambita Community Carbon Project in Mozambique showed that community development-oriented tree planting projects have several economic benefits both monetary and Non Timber Forest Products arising from forestry activities. This helps farmers to

secure additional source of much needed cash to meet their needs and improve their living standards.

Evaluation of title ownership on income showed that a positive relationship exists between land ownership and household income. Owuor *et al* (2007) also found a positive relationship between the two. This is due to ease of access to credit market which serves to improve output or enhancing income diversification by households. Farmers with access to collateral such as the title can easily use it to access loans to smooth out consumption or engage in other productive activities with ease than those without any form of security. Further, access to property rights encourages investment in a resource and this leads to increased resource efficiency and productivity (Besley, 1995) and therefore increased incomes.

The relationship between household head education level and income was found to be positive. As the level of education increases, income increases. Better education enables decision-makers access better farming practices and information regarding improved technology and markets. Further, individuals are able to access rural jobs and undertake income diversification. Alemayehu *et al* (2005) had similar findings on determinants of rural poverty in Kenya. He found out that education significantly contributes to reduced rural poverty by increasing individuals incomes.

CHAPTER FIVE: SUMMARY CONCLUSION AND RECOMMENDATIONS

5.1 Summary

The main aim of the study was to evaluate contribution of The International SmallGroup and Tree Planting Program on household incomes in Nyeri district. Specific objectives included determination of the factors that influence participation and the extent, establish the effects of the program on environmental services and household incomes. Heckman sample selection model was used to determine factors that influence participation and the extent while descriptive statistics were used to determine program's effect on environmental services. Log-log model was used to determine program's contribution to household income. Male headed households dominated the sample and majority derived their livelihood from farming with land holdings being small. Majority of the farmers were also seen to complete secondary level of education with only a few being illiterate.

From the findings, there was no significant difference in income between participants and non-participants. Other socioeconomic, farm specific and institutional were found to be significant in explaining disparity in incomes among the households. Farm size, program awareness and access to microfinance loan were found to be positively influencing participation in the program. Farmers felt that the program had provided a variety of environmental services. The findings of this study agree with previous studies done by Alemayehu *et al* (2005), Antle (2005) Owuor *et al* (2007), and Jindal (2004) among others.

5.2 Conclusion

The findings of the study revealed no significant difference in income between the farmers in the program and those not participating. Nevertheless, there were limitations to the study as only cross-sectional data for 2008 was used. Further, the trees were only four years old and had not reached the peak for carbon credits trading and this may explain insignificance in income contribution. Household incomes could be increased by encouraging collective action so that farmers can benefit from formation of groups and enhance bargaining power, market access and increased technology flow. Further, income diversification should be encouraged which includes engagement in business and salaried employment. Provision of education to enhance better

decision making and access to salaried wage in rural areas and enhancement of property rights so as to encourage investment and better decisions on resources which will ensure they are utilized efficiently.

5.3 Policy Recommendation

TIST program should collaborate with the government and other stakeholders in linking farmers with markets for their produce so as to enable them market their surplus given that improved production practices by participants gives better yields but there is inadequate market for the output. Model of TIST whereby farmers are trained on improved methods of production and given micro-finance loan should be replicated in areas where agro-forestry is viable and this should be guided by cost benefit analysis. This will give a clear picture on the benefits that will be obtained in the future compared to the current cost and there should be comparison of different enterprises to ensure farmers engage in the most beneficial enterprise. Enhancement of property rights by government should be encouraged to ensure long term decision making for instance participation in tree planting and efficient land utilization by women. This will also encourage investment in small-scale projects.

Government should come up with policies that will guide implementations of similar projects to avoid uncontrolled substitution of agricultural land with tree planting enterprise, planting of trees that are detrimental to the environment and ensure farmers are protected from exploitation.

5.4 Further Research

One of the major aims the program was sinking carbon from the atmosphere while at the same time helping farmers improve incomes. This research did not focus on computing the amount of carbon that has been sunk from the atmosphere but focused on program's effect on household incomes therefore, further research on this subject should be done to explore issues that this study was not able to capture like technical issues regarding carbon sinking. Further there is need to look into cost being presently incurred and potential benefits in the future and opportunity cost of the foregone agricultural output and this should be done for the different crops that are grown in the study region. Payment options also need to be evaluated, to better understand whether it is beneficial for farmers to be paid per ton sunk or per tree. These will further assist in coming up with sound policy interventions.

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APPENDIX

QUESTIONNAIRE

1. Date ……

2. Location ……..

3. Division……

Name	Relation to Household head(**A**)	Gender of Household head (male=1 female=2)	Age of Household head	Education level of Household head (**B**)	Occupation of Household head (**C**)	Size of the household	Household members above 18 years

A. Relation to Head

1	Head
2	Wife
3	Child
4	Sibling
5	Parent

B. Education level

1	None
2	Lower primary
3	Upper primary
4	Secondary
5	Tertiary
6	Others

C. Occupation

1	Farming
2	Employed outside Agriculture
3	Own business

TIST Membership and Farm Information.

TIST Members

1. Were you aware of the benefits of the program before joining? (Yes=1, no=0)……

2. What made you join the program, please rank according to importance?

Code	**Reason for joining**	**Rank**
1	Improve income	
2	Access training on health and nutrition	
3	Access training on improved agriculture production	
4	To utilize unused land	
5	To clean environment	
6	Others(specify)	

3. What activities do you feel have benefited you in TIST, please tick.

1	Improved Income	
2	Improved farm output	
3	Improved health and nutrition	
4	Acquired business skills	

Others……..

4. Are there any challenges associated with the program, please tick

1	Reduced land for cultivation	
2	Reduced farm output	
3	Group disagreements	

Others…….

5. Total Farm Area (Acres)……

6. How many acres are allocated to tree planting?.....…….

7. How much did you receive per tree from TIST?……

8. Please indicate the amount you received from other tree products apart from TIST payment…….

9. Do you have a portion in your land that you consider agriculturally unsuitable? (y=1.n=0)…..

10. If yes, Please specify?

1	Steep slope	
2	Rocky section	
3	Valley	
4	Others(specify)	

Others……..

11. Has participation in TIST had any effect on reduction of water and wind soil erosion on your farm, please tick.

1	No effect	
2	Low effect	
3	High effect	

12. Has planting of trees had any effect on improvement of microclimate in the region (yes=1, no=0)

13. Has participation in TIST had any effect on soil fertility on your farm, please tick.

1	No effect	
2	Low effect	

3	High effect	

14. Has participation in TIST had any effect on water quality improvement (yes=1, no=0)

15. Has tree planting improved the beauty of this region (yes=1, no=0)

Non-Members

16. Are you aware of program benefits? (yes =1, no=0)……

17. Do you intend to join TIST? (yes=1, no=0)…….

18. If yes, the reason for intention to join

Code	Reason for joining	Rank
1	Improve income	
2	Access training on health and nutrition	
3	Access training on improved agriculture production	
4	To utilize unused land	
5	To clean environment	
6	Others(specify)	

19. Total Farm Area (Acres)……

Income Source

20. Did any other member of your household have a job or a business in the year 2008?

( ) Yes ( ) No

21. If yes specify

Household member	Job(Employment)	Business	Hours spent per day

22. What was the total monetary contribution from employment to your household's income in the year 2008?……

23. What was the total monetary contribution from business to your household's income in the year 2008?……

24. Did your household receive any remittances in the year 2008? ( ) Yes ( ) No

25. If yes please state the monetary contribution to your household from the remittances in year 2008?……

26. Did your household receive any gifts in the year 2008? ( ) Yes ( ) No

27. If yes please state the monetary contribution to your household from gifts in year 2008?……s……

28. Are you a member of another group? ( ) Yes ( ) No

29. If yes state the monetary contribution to your household from group(s) in year 2008?.....

30. Please specify the group?.....

31. Other sources of income (Specify)

Source	**Amount**
Loan from MFI (yes=1,no=0)	
Loan from other sources(yes=1,no=0)	

32. Crop Enterprise Information

Season one				**Season two**			
Crop	**Yield (Kgs)**	**Price per kg**	**Value of sold output**	**Crop**	**Yield (Kgs**	**Price per kg**	**Value of sold output**

33. Livestock Enterprise Information

Description	**Yield Milk, meat, eggs. Others(Specify)**	**Units sold**	**Price per unit**	**Value of sold output**

34. Did you attend any agricultural seminar in year 2008? ( ) Yes ( ) No

35. What is the nature of land ownership?

Code	Tenure System
1	Personally owned
2	Family owned
3	Leased
5	Others, specify

36. How far is the nearest market in kilometers?.....

THANK YOU