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# Factors Influencing Adoption of on-Farm Tree Planting in Shinyalu Sub-County, Kakamega, Kenya

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**Abstract:** *Throughout the world, deforestation continues at an alarming rate of about 13 million hectares a year. Human activities are by far the most common and most destructive cause of deforestation in Africa and other tropical regions. On-farm tree planting has therefore been promoted for decades as an intervention to ease local community dependence on forest resources in Kenya with little success. There is also a dearth of information on the main factors that influence adoption of on-farm tree planting. Most rural people depend on forests for firewood, timber, and other products, hence the need for adoption of on-farm tree planting to ensure sufficient supply and reduce dependence on forests. This has not been achieved due to the scarcity of resources as a result of the high poverty rates in the area. This study therefore sought to determine the factors that influence adoption of on-farm tree planting premised on the fact that farmers allocate land to on-farm tree planting based on the household subsistence needs and surplus to earn income for the household. The study population of 13,411 households consisted of farming households from Shinyalu Sub-county. Simple random sampling was used to select a sample size of 384 respondents from households. Primary quantitative and qualitative data was collected using semi-structured questionnaires, key informant interview guides and focus group discussion guides. Quantitative data was analyzed using descriptive statistics, frequencies and cross tabulation analysis. Qualitative data was analyzed using content analysis. Data was analyzed and interpreted using descriptive statistics, frequencies and cross tabulation analysis. The findings of the study showed that the main factors influencing adoption of on-farm tree planting were; land size, family size, education level and distance from the home to the forest. The land sizes were very small with majority of the respondents having less than 2 acres. With the small land sizes of less than 2 acres and large families of over 10 members, they opted to plant food crops and rear livestock for milk production in order to feed their families. Ancestral accession is also a major contributor to the low adoption of the practice since land has to be sub-divided many times to all the male children in the home. Households with more than 10 members planted fewer trees while those with few family members planted more trees. The most educated people planted more trees while the least educated planted fewer trees. Households closer to the forest planted fewer trees while those far from the forest planted more trees. This study recommends that sensitization and training of farmers should be done on the importance of on-farm tree planting, propagation of seedlings, and nursery management practices for sustained production and continued planting of trees on farms.*

**Keywords:** *Adoption, On-farm tree planting, Factors, Household*

## 1. INTRODUCTION

In many parts of Kenya, a farmer's decision to plant trees on their farm is influenced by household and field characteristics. It is however commonly misconstrued that farmers often compare the economic benefits of land use practices and end up preferring agricultural practices to tree planting because of the high income rates. This is however not the case, the amount of profit may not be the only factor that determines on-farm tree planting. A study in Central Kenya showed that despite the fact that coffee and tea earn very high profits of up to four times more than *Acacia mearnsii*, the tree was still very widely adopted in the area (Dewees 1991).Previous studies have shown that factors such as age, education level, income, family size, labour, land size, distance to market, distance to the forest, membership in social groups, among others have determined the adoption levels of on-farm tree planting in other areas Kakuru et al (2014).

Most farmers in Shinyaludo, or would like to plant trees on a significant scale but face great difficulties in reaching their planting targets.The high population in Shinyalu has led to subdivision of land into smaller units and intensified maize cultivation to feed the large population. This has made it difficult for the locals to plant trees on their farms in an attempt to maximize on maize production. In order to meet timber and other household needs, the locals have turned to the natural forest to obtain tree products. This implies heavy dependence on their farm to support family needs and more reasons to encroach the forest to do farming or harvest forest products. Livelihood activities done by households contribute to the destruction of the forest.

The success of environmental conservation through on-farm tree planting depends largely on the involvement of households. Their involvement also helps in preservation of biodiversity and other natural resources. People with diverse profiles have adopted on-farm tree planting. Governments and various organizations who are dedicated to conservation of the environment have carried out sensitization programs to help increase the coverage of trees on-farm. However, not everyone has taken up the practice. There are different factors which contribute to their decision to adopt or not. This paper therefore presents an analysis of one of the major activities of households in the study site. More specifically, it ventured into the determination of factors influencing adoption of on-farm tree planting. The study attempted to determine and describe the major factorsinfluencing adoption of on-farm tree planting by household residents in Shinyalu Sub-County.

## 2. STUDY AREA AND METHODOLOGY

This study was undertaken in Shinyalu Sub-county, in Kakamega County.Shinyalu is situated in Western Kenya adjacent to the western portion of Kakamega forest, 35 km from Lake Victoria, and approximately 1.6 - 22.4 km east of Kakamega town. The Kakamega forest reserve bordersIleho Sub-county to the North and ShinyaluSub-county to the South(BIOTA 2010).

Shinyalu has a human population of 118,049 with four locations (KNBS 2009). The inhabitants of Shinyalu are the Isukha of the Luhya tribe. TheSub-county is mainly characterized bysubsistence farming and a few off-farm activities such as employment and retail businesses. Forestry has a long history dating back to 1940s when Eucalyptus species was introduced to reverse deforestation and provide scarce forest materials for domestic use. 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 family and household sizes are relatively large with an average of about 9 members per household which is quite high compared to the limited resources upon which the communities depend on. The households have small land sizes of about 0.5 acres per family. Access to land as a factor of production has been hindered by land fragmentation (BIOTA 2010).

The inhabitants of Shinyalu Division are primarily dependent on the forest for their livelihood.The forest is the only rain forest in Kenya and is the furthest east remnant of the Guinea-Congolean rain forest. According to the 2014 Economic survey, 52.1% of the population in the area lives below the poverty line, meaning that they can hardly afford basic necessities like food, shelter, clothing, and education. As such there is a heavy reliance on the forest to supplement their daily necessities, high prevalence of forest resource utilization takes place throughout the year with minimal utilization being affected by the dry and wet seasons. For example, fruits and vegetables are mainly collected during the wet season, while grass (for thatching) is collected during the dry season. The most utilized resources all year round are firewood, pasture/grass, medicinal herbs, charcoal, mushroom and timber (BIOTA 2010).

## 3. METHODOLOGY

Two locations in Shinyalu were selected for the study; Shibuye and Murhanda. The two locations are each divided into 4 sub-locations. Within each sub-location, the villages to be visited were identified with the assistance of Community Forest Association officials. Villages that were close to the forest and those that were far from the forest were both selected. Simple random sampling was used to select the number of households in each village. Proportionate allocations of the samples between Shibuye location, which has 7,420 households, and Muranda, which has 5,991 households, was applied in accordance household numbers per 2009 Kenya population census report (KNBS 2010). Therefore, 55% of the households were sampled from Shibuye and 45% from Muranda. Data

collection was done with the help of locally recruited and trained enumerators from each of the two locations.

In each location, 10 key informants were interviewed. A key informant was selected based on the following criteria: familiarity with the area and the local people, having broad and in-depth knowledge ofthe village, its households and the forest uses. The key informants were mainly elderly men and women and the disabled. The elderly were selected because they have been around long enough to tell the transition that has occurred in the area. 2 focus group discussions were also held in each location. Each focus group discussion had 10 participants consisting of men, women, youth, the old and disabled to give varied views. The focus group discussions helped reach a consensus on key qualitative matters.

Semi-structured questionnaires were used to conduct interviews and collect both qualitative and quantitative data within the households. The questionnaires obtained socio-economic and demographic data (income sources, total household income, value of assets, land size, farming practices, livestock size, education years of members of household, membership in associations or groups, household size) household contextual factors (distance to the forest, ethnicity, frequency of forest use, time spent and number of household members involved).

## 4. Results and Discussion

The main factors influencing adoption of on-farm tree planting were determined through ranking. Various factors were listed and the ones that were most important and least important in influencing adoption of on-farm tree planting were highlighted. The factors that were ranked very important were: Land size (70.8%), family size (63%), education level (67.8%), and, access to existing forest/ distance to the forest (93.6%). The least important factors were: Age of household head (35.6%), farm and off-farm income (34.8%), distance to roads (30.9%), gender (27.9%), and, access to credit (38%).

**Table1.** *Factors influencing adoption of on-farm tree planting*

| Factors influencing adoption | Rank of factors influencing adoption of on farm tree planting | | | | Total |
|---|---|---|---|---|---|
| | Very important | Important | Not important | Not important at all | |
| Age | 114 (29.7%) | 23(6.0%) | 110 (28.6%) | 137 ( 35.7% ) | 384 (100.0%) |
| Land size | 159 (41.4%) | 115 (29.9%) | 98 (25.5%) | 12 (3.1%) | 384 (100.0%) |
| Family size | 71 (18.4%) | 173 (45.1%) | 103 (26.8%) | 37 (9.6%) | 384(100.0%) |
| Farm and off-farm income | 37 (9.6% ) | 97(25.3%) | 137 (35.7%) | 113(29.4%) | 384(100.0%) |
| Education level | 187 (48.7%) | 75(19.5%) | 89 (23.2%) | 33 (8.6%) | 384(100.0%) |
| Availability of market | 139 (36.2%) | 112 (29.2) | 85(22.1%) | 48 (12.5%) | 384(100.0%) |
| Distance to roads | 74 (19.3%) | 45(11.7%) | 135(35.2%) | 130(33.9%) | 384(100.0%) |
| Access to existing forest services/ Distance to the forest | 145(37.8%) | 216(56.25%) | 16(4.2%) | 7 (1.8%) | 384(100.0%) |
| Gender | 50 (13.0%) | 55 (14.3%) | 125(32.6%) | 154(40.1%) | 384(100.0%) |
| Access to credit | 49 (12.8%) | 89 (23.2%) | 103(26.9%) | 143(37.2%) | 384(100.0%) |

### 4.1. Age of Household Head

The age of the household head does not influence adoption of on-farm tree planting. The respondents who felt that age of the household head is not an important factor were 64.3% (246) while only 35.6% (138) felt it is very important (Table 4.8). Contrary to this scenario in Shinyalu, other studies have shown that, age affects the decision of farmers to participate in on-farm tree planting (Alassaf et al. 2011). Older farmers are more likely to participate in on-farm tree planting because their opportunities to be employed or engaged in other livelihood activities is more limited compared to younger people who tend to have more employment choices. In Vietnam, according to Thoai and Rañola (2010), age, which reflects upland farmer's farm experience, is one of the most important factors affecting the decision of upland farmers to participate in on-farm tree planting. Lwayo and Maritim (2003) support these findings by asserting that age and the decision to adopt farm forestry have a positive relationship. The age of the farmer affects knowledge and awareness of activities in the surrounding environment. Age, as concluded by Lwayo and Maritim (2003), affects one's ability to adopt farm forestry.

In Western Uganda, younger household heads are more likely to adopt on-farm tree planting compared to the older farmers (Thangata 1996). This is probably because the younger households are ready to take risk relative to older households and thus likely to adopt on-farm tree planting. Adesina, et al. (2001), also agreed with this study by reporting adoption of tree planting decreases with advanced age. Age has largely been found to be significant in deciding whether to continue with the technology or not (Ajayi, et al. 2006). Older farmers were not willing to continue with the technology as compared to younger ones.

The results of this study that show that age is not an important factor may be explained by virtue of the fact that there is a very high unemployment rate in the area. Most of the household heads have no alternative sources of income apart from farming and other agricultural activities on their farms. So regardless of the age of the household head, if he decides he will not plant trees on his farm, it will be a personal decision but not because there are a myriad of other opportunities for him to select from.

### 4.2. Family Size of the Household

Households with family sizes of 10 members and above had the lowest mean number of trees planted on their farms. Those with smaller family sizes had the highest number of trees on their farms. The study showed that the family size of the household affects adoption of on-farm tree planting in Shinyalu. The respondents who felt family size of the household was an important factor were 63% (244) while those who felt it was not were 36.4% (140).

**Table2.** *Family size of the household*

| No. of individuals in the household | Average No. of trees on-farm | Average No. of trees planted within 1 year |
|---|---|---|
| 10 and above | 65.90 | 15.93 |
| 7-9 | 78.01 | 17.60 |
| 4-6 | 83.62 | 24.83 |
| 0-3 | 136.67 | 42.79 |
| **Grand Total** | | **32.68** |

Depending on the number of people in the household and the size of the land they own, on-farm tree planting can either be taken up as a beneficial activity to the home or it may be looked at a waste of space that could otherwise be used for crop production to feed large family sizes (Alassaf et al 2011). In Shinyalu, family size was rated as a very important factor influencing adoption of on-farm tree planting. Most of the respondents with family sizes of 10 members and above had the lowest mean number of trees planted on their farms (65.9), family sizes of 7-9 members had a mean of 78 trees, family sizes of 4-6 members had a mean of 83.6 trees planted on their farms. This shows that the larger the family size, the fewer the number of trees planted. This can be explained by the cultural belief that sons in the home have to be sub-divided part of their father's land. Households that have more children will therefore plant fewer trees because the land that would have been used to plant trees will be allocated to the male children. On the other hand, in cases where the children are many and they are female, fewer trees will still be planted, because the land will be put under crop production to feed the large family size. Similarly, a study carried out in Rwanda has shown that households that have many children aged 16 and above including adults are more involved in farming activities (Ndayambanje et al. 2012). Thangata (1996) had a different opinion, contrary to the findings of this study. He stated that, the higher the number of children in a household, the higher the need for tree products and therefore the more the number of trees planted due to the readily available labour.

### 4.3. Effect of Farm and off- Farm Income

In table 4.10 below, 131 (34.1%) respondents felt that farm and off farm income was an important factor while 253 (65.9%) felt it was not. The data further shows no positive relationship between farm and off-farm income and adoption of on-farm tree planting.

**Table3.** *Effect of farm and off-farm income*

| Responses on the effect of farm and off-farm income | Frequency | Percent (%) |
|---|---|---|
| No | 253 | 65.9 |
| Yes | 131 | 34.1 |
| **Total** | **384** | **100.0** |

The results of this study showed that majority of the inhabitants in Shinyalu were farmers (83.3%) while only 16.7% had other sources of off-farm income (Table 4.5). High unemployment rates have made it difficult for the locals to get off-farm income and therefore solely rely on their farms for their daily bread. The few available County government jobs that could provide off-farm income are highly competitive with tough academic requirements that the locals cannot meet due to the high illiteracy levels in the area. In Ethiopia, the scenario is different. A study carried out by Mekonnen (1998) proved that, households with more income and higher proportion of off-farm income are more likely to plant trees. This could be the case because the households are financially stable and can therefore afford large tracks of land to allocate trees, but in Shinyalu, due to high poverty rates, the small farms can only be sub-divided so much to accommodate the homestead, crops, livestock and a few trees. In Rwanda, households that have higher income are expected to plant less trees as compared to lower income households. This is because the high income households can afford to buy wood products and therefore do not need to plant trees (Ndambaje et al. 2012).

### 4.4. Gender Roles in Tree Management

The study results showed that husbands (men) were the main managers of trees planted on-farm (69.0%), tending (52.6%), ownership (64.1%) and they also decide when to harvest and cut the trees on the farm (67.0%). Table 4.8 shows that 27.3% (105) of the respondents felt that gender is a very important factor while 72.7% (279) felt that it is not an important factor. Gender is therefore not an important factor in determining adoption of on-farm tree planting as the community preconceives tree planting as a man's job.

**Table4.** *Gender roles in tree management*

| Activity | Responsibility | No. of respondents | Percent (%) |
|---|---|---|---|
| Who plants trees on farm | Wife | 13 | 3.4% |
| | Husband | 265 | 69.0% |
| | Both wife and husband | 16 | 4.2% |
| | Children | 44 | 11.5% |
| | Whole family | 44 | 11.5% |
| | Workers | 2 | 0.5% |
| Who tends to the trees | Wife | 53 | 13.8% |
| | Husband | 202 | 52.6% |
| | Both wife and husband | 46 | 12.0% |
| | Children | 15 | 3.9% |
| | Whole family | 68 | 17.7% |
| Who owns the trees | Wife | 48 | 12.5% |
| | Husband | 246 | 64.1% |
| | Both wife and husband | 35 | 9.1% |
| | Children | 10 | 2.6% |
| | Whole family | 45 | 11.7% |
| Who decides when and how to harvest them | Wife | 55 | 14.3% |
| | Husband | 257 | 67.0% |
| | Both wife and husband | 32 | 8.3% |
| | Children | 9 | 2.3% |
| | Whole family | 31 | 8.1% |

Basically, it is the man who is in charge of anything to do with land and the available resources. Cultural beliefs inhibit women from planting or taking care of trees. It is believed that tree planting is a man's job. A study by Pattanayak et al. (2003) had a similar opinion. They found that gender does not influence tree planting activity, with male headed households or households with more male members being found to be more active in tree planting.

Contrary to this, a study done in Jordan by Thoai and Rañola (2010) figured out that gender is negatively associated with the decision to plant trees on-farm. The male household head and the young children would rather not engage in on-farm tree planting, they would prefer other financially stable work. This shows that as much as in Shinyalu, women are not allowed to manage trees, in other countries, it is a woman's job. In Rwanda for instance, women contribute 40-80% of agricultural farm labor, much as they have husbands in the home. They are therefore the decision makers in crop production and on-farm tree planting (Randolph and Sanders 1992).

### 4.5. Access to Credit Facilities by the Household Head

Majority of the household heads did not own bank accounts and had never accessed credit in any financial institution as indicated by the results in figure 4.4 below. Those who did not have bank accounts were 85.5%, those who did were 14.5%, while those who had never accessed any credit facilities were 90.8% and those who had accessed credit were 9.2%. This therefore means that access to credit facilities is not an important factor in determining adoption of on-farm tree planting as indicated in table 4.8 where 38.2% (147) felt it is a very important factor while majority, 61.8% (237) felt it is not important at all in adoption of on-farm tree planting.

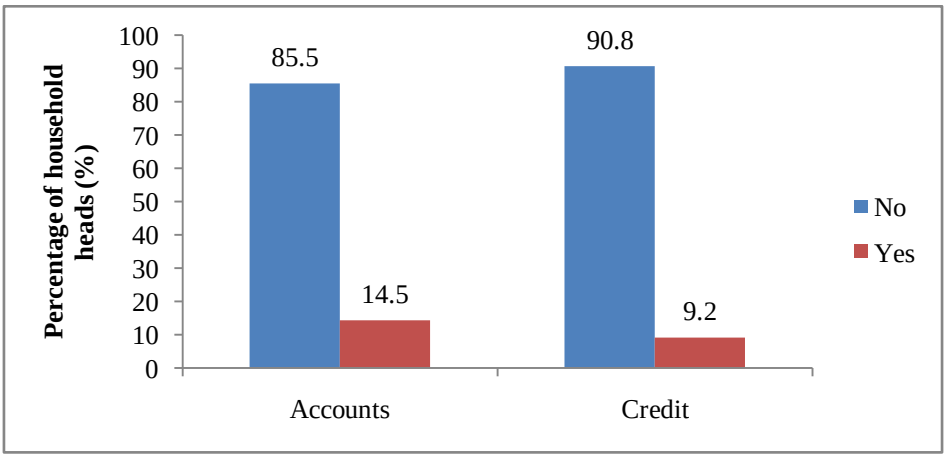


**Figure1.** *Access to credit facilities*

This could be the case because most of these households do not have a large source of income, the little they make from the sale of farm produce is sufficient to provide for the family at that particular moment in time without any surplus remaining for saving. They therefore see no need of opening bank accounts without an adequate and consistent source of income. A study carried out in Central Kenya showed that those who had off-farm employment opportunities, access to credit and total household income may be associated with reduced tree felling on farm leading to high probability of tree retention (Oeba et al. 2012). Access to credit enables a farmer to buy or rent land for tree planting, he will also be able to buy high quality tree seedlings that when planted will have a high survival rate and therefore enhance on-farm tree planting. This is contrary to the study where access to credit has no effect at all on adoption of on-farm tree planting.

According to Carnea (1992), access to credit facilities should be given to farmers as incentives to stimulate small-scale tree planting. Other authors, however, feel credit should only be provided if it is well targeted and actually needed (Haltia and Keipi 1997). The very poor who do not have access to credit or loans for tree planting and management should be given priority. Some authors, however, have criticized access to credit and loans as they can cause dependency and be risky if expected out-comes are not reached (Arnold 1997).

Access to credit could either have a positive outcome for tree planting, or it can lead to unsustainable tree plantations. If a farmer is only interested in tree planting to make money, then, chances are that he may not manage the plantation well and the yields will not also be of good quality (Haltia and Keipi 1997, Thacher et al. 1997). It is therefore very important that the farmer has good intentions of tendering and managing well the trees he has planted from the money given on credit.

### 4.6. Education Level of the Household Head

Table 4.12 below shows that there was a strong relationship between education level of the household head and the average number of trees planted on-farm. Education is a very important factor because the most educated people had more trees on their farms. The table below indicates that those with University education had a mean of 300 trees on their farms, college had 245.92, those with secondary education had 206.92, primary education had 150.77 and lastly those with no education had 140.50 on their farms.

**Table5.** *Level of education and the mean number of trees planted*

| Highest education level | Number of trees (Mean) | N | Std. Error of Mean | Std. Deviatin |
|---|---|---|---|---|
| University | 400.00 | 1 | | |
| College | 245.92 | 42 | 67.667 | 417.129 |
| Secondary | 70.92 | 149 | 46.136 | 617.256 |
| Primary | 30.77 | 177 | 38.417 | 468.935 |
| None | 20.50 | 15 | 74.460 | 278.603 |
| **Total** | **201.08** | **384** | **27.389** | **534.619** |

This is probably because, those who are learned have more knowledge on the proper ways to plant trees, the best quality of seedlings and the right species to plant. They could also be more financially stable since going to school has made them get well-paying jobs and therefore earn more income to enable them acquire large tracks of land to place under tree planting. Another possibility could be that the more educated people understand the need to conserve trees and therefore they do not cut them aimlessly. They could also be less dependent on trees for firewood which reduces the number of trees on-farm because they can afford to buy cooking gas as an alternative source of energy.

Other studies have shown a similar result; the level of education of the household head has a positive effect on on-farm tree planting. People who are more educated have more income opportunities. They can afford to put more land under tree planting (Haglund et al. 2011; Muhammad et al. 2011). According to Brahmi and Thakur, (2011) and Alassafet al.,(2011), illiteracy greatly contributes to one's decision not to plant trees on their farm. Lwayo and Maritim (2003) also indicated that formal education is a vital aspect in a farmer's decision to adopt on-farm tree planting and it influences the effectiveness of the decision to participate in such activities. A farmer who is formally educated can readily have access to information on the value of farm forestry and therefore take up the practice easily. Naidu (1992) also stated that education and people's participation were very important factors in on-farm tree planting.

Blaug (1972) asserted that one's ability to capitalize on opportunities is improved by education. An educated person is generally more flexible and more motivated. He adapts himself more easily to changing circumstances. He benefits more from work experience and training, and, acts with greater initiative in problem-solving situations. In general, an educated person is more productive than a less educated person, even when his education has taught him no specific skills (Blaug 1972). Similar findings (Masangano 1996) revealed that education is positively associated with the probability to adopt agroforestry technologies. Thangata (1996) also observed that education level of the household head is an important determinant of adoption of on-farm tree planting because formal and informal training has the potential to increase the rate of adoption by directly increasing awareness, imparting skills and knowledge of the new technology. A study done in Rondonia, Brazil, Campeche, and in Mexico indicated that exposure to information about tree planting and the level of educational achievement all play significant roles in the decision to adopt on-farm tree planting (Casey et al. 2000).

Contrary to the above, Thoai and Rañola (2010) concluded that the level of education is not an important factor affecting an upland farmer's decision to either take up or not on-farm tree planting in the northwest mountainous regions of Vietnam. This is because though the upland farmers are more educated than the minority groups, they are still bound by strict rules regarding the importance of tree planting. This compels both the educated upland farmers and the uneducated minority groups whose livelihoods depend so much on the forests and trees to plant them in adherence to the community rules regarding forestry.

### 4.7. Land Size of the Household Head

The land sizes varied with majority 258 (67.2%) of the respondents having land sizes of less than 2 acres, and very few 30 (7.8%) having 4.5acres and above.

**Table6.** *Land size categories and mean number of trees planted*

| Acreage | Mean | N | % | Std. Error of Mean | Std. Deviation |
|---|---|---|---|---|---|
| ≤ 2.0 acres | 150.67 | 258 | 67.2 | 24.022 | 385.85 |
| 2.0-3.0 acres | 155.27 | 70 | 18.2 | 36.761 | 307.57 |
| 3.0-4.5 acres | 319.88 | 26 | 6.8 | 91.847 | 459.23 |
| 4.5 ≥ | 535.55 | 30 | 7.8 | 225.52 | 1295.51 |
| **Total** | **195.37** | **384** | **100.00** | **27.007** | **530.60** |

This land size is very small considering the various sub-divisions that have to be done on the land, the large household sizes that rely on the small piece of land and the high poverty rates that require optimum food production to feed the large families. This amounts to great pressure on the land hence difficulty in adopting on-farm tree planting.

There were three main types of land ownership, 40.4% (155) of the respondents had individual ownership with a mean land size of 0.79acres, 59.1% (227) had family ownership with a mean land size of 1.03 acres and 0.5% (2) had rented land with a mean land size of 0.5 acres.

**Table7.** *Type of land ownership*

| Type of ownership | No. of respondents | Mean (Acres) | Std. Error of Mean | Percent (% ) |
|---|---|---|---|---|
| Individual | 155 | 0.7931 | .07192 | 40.4% |
| Family | 227 | 1.0288 | .05929 | 59.1% |
| Rental | 2 | 0.5000 | .00000 | 0.5% |
| **Total** | **384** | **0.9361** | **.04590** | **100.0%** |

Despite the fact that these land sizes are relatively small, the type of ownership is also quite limiting to allocation of land to tree planting. 59.1% (227) of the respondents have land that is owned by the entire extended family. This means that the land is divided amongst all the children in that home and these children are grown up men with families, and they also need to sub-divide the small portions of land they have to their male children. Owing to the fact that some farmers do not own land, they end up cultivating on borrowed or rented land. In this circumstance, long term investments on land such as tree planting would not be feasible for them. The relatively long time periods involved in tree farming exposes farmers to risks in terms of price fluctuations, tenure insecurity and natural hazards (Angelsen, 2003). The long waiting period and high risks do not favor poor farmers, who are highly dependent on their limited farm resources; often for day to day survival (Dewees and Saxena 1997). The only farmers who are able to cope with the extended payback period between tree planting and harvesting are those with on-farm food supply, off-farm income sources, or access to affordable loans (Arnold 1997). A study by Salam et al (2000) showed that the poorest farmers in the tropics generally have very little ownership or access to private land or only very small areas of land, yet tree planting requires a lot of land. They therefore have little or no choice but to plant staple food crops that provide annual returns, instead of the relatively slow growing trees.

**Table8.** *Land use system*

| Land use system | Mean (Acres) | Std. Error of mean | No. of respondents | Percent (%) |
|---|---|---|---|---|
| Agricultural crops cultivation | 0.92 | 0.04 | 382 | 99.5 |
| Livestock rearing paddock | 0.47 | 0.02 | 176 | 45.8 |
| Fodder crops cultivation | 0.46 | 0.03 | 114 | 29.6 |
| Homestead | 0.42 | 0.01 | 371 | 96.6 |
| Fruit orchard | 0.34 | 0.03 | 60 | 15.6 |
| Woodlot/ forest | 0.56 | 0.03 | 245 | 63.8 |

The study also determined the land use system, and it was evident that 99.5% of the respondents had crop cultivation as the main farming practice, 63.8% had tree planting, while 45.8% reared livestock. Crop production is popular probably because of the large families that need to be fed and the small farms that cannot accommodate tree planting alone and leave out crop farming. According to Ajayi et al (2003) land size has a positive association with farmers' decisions to plant trees on their farms. Tree planting farmers own larger land areas compared to non-tree planters, a pattern found in other studies in the tropics (Salam et al. 2000, Summers et al. 2004). Most of the small-scale farmers in many African societies fall within the customary tenure system whereby families depend on acquiring land through ancestry accession. This means that each family is restricted to sharing land that belongs to their forefathers. Therefore, as family size increases, their share of land gets smaller since they have to pass on portions to the younger generation. As a result, the land is too small to plant trees and food production has to be prioritized.

It is evident that farmers with larger areas of land tend to plant and manage trees more than the farmers with limited land (Amacher et al. 1993, Thacher et al. 1997, Summers et al. 2004). Contrary to the study, other findings have shown that, at times, poor farmers with small land areas have high densities of trees on part of their farms, because they are dependent on essential forests products such

as firewood that may be otherwise scarce (Scherr 1997). Furthermore, as farmers are often highly dependent on the limited resources produced on their land for their livelihoods, they have an incentive for managing their crops, including trees, in the most sustainable and efficient way (Sen and Das 1988). Scherr (2004) points out the advantage of having a small land size. He states that small land areas can be more easily protected from damage such as forest fires or diseases, and there is an incentive to focus on quality production. He adds that they may have disadvantages too because they provide small volumes of wood, which can make harvesting and transportation to the market uneconomical.

### 4.8. Distance from the Household to the Forest

The results indicated that distance from the household to the forest is positively correlated to the number of trees planted on-farm in the study area. The table below indicates that there were fewer trees planted (398.4)at a distance of less than 0.5 km from the house to the nearest forest edge and more trees (823.3) planted at a distance of 1.5-2.0 km further from the forest.

**Table9.** *Trees planted and distance to the forest*

| Distance (km) | Mean No. of trees planted | Std. Error of Mean | Std. Deviation |
|---|---|---|---|
| ≤0.5 | 398.4 | 70.640 | 607.667 |
| 0.5-1.0 | 576.9 | 98.313 | 963.270 |
| 1-1.5 | 697.8 | 206.265 | 545.726 |
| 1.5-2.0 | 823.3 | 284.801 | 1305.123 |

This could be the case because those households that are located close the forest feel that the forest can provide their tree product needs and they therefore do not have to plant trees. They also feel that the forest is nearby, and it would be very easy for them to walk there to collect firewood for instance, several times in a day without getting tired. On the other hand, households that are located far away from the forest would find it an uphill task walking for over 2km in search of firewood, so they would rather plant their own trees to supply their tree needs.

The table below outlines the products obtained from the forest depending on the distance to the forest.

**Table10.** *Distance to the forest and forest products*

| Distance | Products | Units | Mean Quantity obtained | Average times per month |
|---|---|---|---|---|
| ≤1.5km | Firewood | Head load | 2.52 | 13.55 |
| | Grass for fodder | Bundle | 2.75 | 7.4 |
| | Grazing | Number | 7 | 28 |
| | Medicinal extracts | Kg | 4 | 5 |
| 1.5Km≥ | Firewood | Head load | 1.83 | 7.14 |
| | Grazing | Number | 4.67 | 17.5 |

The results of the study further showed that those that live near the forest sourced more products from the forest at a higher frequency than those that live far from the forest. For example, a person that lives less than 0.5km gets a mean of 2.52 head loads of firewood at an average of 13.55 times in a month while one who lives more than 1.5km from the forest gets a mean of 1.83 head loads 7.14 times in a month. According to Lionberger (1960), Raintree (1983), Rogers (1995), farmers may not incorporate trees on their farms for tree products if there is no perceived shortage of tree products, even if there is severe deforestation. They would rather destroy the forest that is near them than plant trees on their farms. This shows that farmers are comfortable taking advantage of the nearby forest rather than planting trees on their own farms. This is very dangerous because the forest will soon be completely depleted and create serious environmental degradation that will affect the very users of the forest.

## 5. Conclusions and Recommendation

The study determined the main factors that influenced adoption of on-farm tree planting in Shinyalu. These were: Family size, education level, land size, and distance to the forest. Addressing these factors will have a significant change in terms of how the locals perceive on-farm tree planting.

The Kenya Forestry Research Institute should organize and carry out trainings and sensitization programmes for local farmers on the importance of on-farm tree planting, propagation of seedlings,

and nursery management practices for sustained production. Economic valuation of various tree species should also be done and farmers educated on the value of each species and the amount of money each can earn. Farmers should be assisted in farm planning to enhance optimal allocation of land to competing land uses.

Studies that optimize tree-crop-soil interactions should also be undertaken as a mechanism for enhancing integration of trees into croplands including fruit trees and fast growing fodder tree species to improve livestock production. A model for diagnosing land use problems and for recommending appropriate interventions, and monitoring and evaluating impacts of tree planting should also be developed. Institutional support through incentives such as subsidies to farmers who buy seedlings, technical support and creation of market opportunities will also boost private investment in tree planting.

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