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Adoption of *Calliandra calothyrsus* and *Sesbania sesban* in Masaka and Rakai District, Uganda

Mukadasi Buyinza and Concepta Mukasa
Faculty of Forestry and Nature Conservation,
Makerere University, Box 7062 Kampala, Uganda

Abstract: *Calliandra calothyrsus* and *Sesbania sesban* multipurpose agroforestry species are being promoted in Sub Saharan Africa to solve the problem of soil productivity and fuelwood scarcity. *Vi Agroforestry* Project and other development agencies in Uganda are promoting them as fuelwood sources. However, little is known about their rates of adoption. An effort was undertaken in Masaka and Rakai district, Uganda to assess the rate of adoption of the 2 tree species. Primary data was collected using survey methodology, three focus group meetings were held in each zone making a total of six meetings in the two zones. Open-ended interviews were used with non-government and government extension officers and with key informants in the area. Observation and physical counting of trees for every tenth household surveyed was done. The results of the Logit analysis model show that there is a strong relationship between on-farm income source, frequency of extension services, use of *Calliandra* as fodder and on- farm sources of firewood and adoption. The other household-level socio-economic characteristics such as age, income levels and farm experiences have not have a significant effect to the adoption of *Calliandra* and *Sesbania*. On the basis of the findings of this study, therefore, the role of policy makers in devising appropriate demographic and socio-economic policies to accelerate the rate of adoption appears to be important in the areas with conditions similar to those in Masaka and Rakai district, Uganda.

Key words: Agroforestry, *Calliandra calothyrsus*, *Sesbania sesban*, adoption, Uganda

INTRODUCTION

Agroforestry technologies have been developed as one way of solving the problems of land and forest degradation and the resultant problems of poverty and food insecurity in the rural areas of most developing countries, Uganda inclusive. Agroforestry considers the suitability of trees for land-use systems unlike agriculture which used to consider only trees with horticultural value and conventional forestry their timber products value (Arnold, 1997). The characteristic that is considered for the suitability of tree species in agroforestry is their ability to be intercropped with either other trees or crops in farming systems. *Calliandra calothyrsus* and *Sesbania sesban* are multipurpose trees that are suitable for a wide range of ecological zones and they also give a variety of services and products in agroforestry systems which are for both economic and ecological value (Masangano, 1996).

Trees in agroforestry systems play a number of roles which enhance agricultural production and contribute to livelihoods of the communities such as; provision of a variety of products and services such as fodder, food, firewood, bee forage, stakes, soil fertility improvement, soil erosion prevention and shade provision.

Agroforestry improves soil fertility through production of leaf litter and its decomposition (Masangano, 1996) and by extracting nutrients that are below the rooting zones of most annual crops and avail it to crops through leaf fall. This reduces the rate at which leaching takes place in agroforestry systems (Buresh and Tian, 1997).

Some agroforestry practices such as contour hedgerows significantly reduce soil erosion and runoff on steep slopes.

Adoption rate is defined as the relative speed with which an innovation is adopted by members of a social system (Rogers, 1983). It is measured as the number of individuals who adopt a new idea in a specified period. The interaction between characteristics of the farmers', farms and the technology is what makes a technology acceptable or repulsive to the farmer and therefore has a

Correspnding Author: Mukadasi Buyinza, Faculty of Forestry and Nature Conservation, Makerere University, Box 7062 Kampala, Uganda

direct impact on its adoption and on the rate at which it is adopted. Some of the farmers' characteristics that may influence adoption rate of agroforestry technologies are age, education, gender of household head, wealth, family size, group membership and farm resources are; farm size, land tenure, credit, or other inputs and labour (CIMMYT, 1993). Farmers' adoption behaviour, especially in low income countries like Uganda, is influenced by a complex set of socio-economic, demographic, technical, institutional and bio-physical factors Van den Ban and Hawkins. The adoption potential of a technology depends on its biophysical performance, its profitability and its acceptability to farmers (Masangano, 1996; Denning 2001; Franzel *et al*., 2001). The goal of this study was to assess the adoption rate of *Calliandra calothyrsus* and *Sesbania sesban* in Masaka and Rakai Districts. The specific objectives was to examine the relationship between selected household characteristics and adoption rate of *Calliandra calothyrsus and Sesbania sesban* tree species. The characteristics of the adopters and non adopter farmers of Rakai and Masaka districts in Uganda were examined.

MATERIALS AND METHODS

The study to assess the adoption rate of *Calliandra calonthyrsus* and *Sesbania sesban* was undertaken between September, 2002 and June, 2003. A survey of 120 households was conducted in areas where dissemination has taken place since 1992 by Vi Agroforestry project in Masaka and Rakai Districts. The parameters which were considered were age, marital status, sex of the household head, education levels of the farm managers and respondents, types and numbers of livestock kept, types of crops grown, family size, membership to community group, farm size, information about *Calliandra and Sesbania* when, how and where it was planted and harvested, its uses, management and constraints, firewood sources, extension services, on or off farm source of income. Surveys also sought information about household characteristics such as decision-making structure regarding planting of trees on the farm, income levels, fragmentation of holdings, land tenure status, other trees on the farm and their uses, proportion of the farm under tree cover and under *Calliandra* and *Sesbania* and government policies influencing adoption.

Study area: Masaka and Rakai Districts, which until 1980 were one district are located in the central region of Uganda. Masaka and Rakai districts lie between latitudes 0°-1° 44'South and longitudes 31 and 32° East. Masaka district is bordered by Mpigi and Mubende districts to the North, Sembabule district to the north-west, Rakai Districts to the west, south and southeast and Kalangala district to the East and South-East. Rakai District is bordered by Masaka district to the east, north and north east, Mbarara District to the west, Ssembabule district to the north west, Lake Victoria to the south east and the Republic of Tanzania to the south. Masaka District has an approximate area of 4,692 km^2 and Rakai district 4989 km^2.

Masaka district has a population of approximately 767,759 people while Rakai's has approximately 471,806 people (UBOS,2002). Both Masaka and Rakai districts lie in the modified equatorial climatic zone and are under the influence of Lake Victoria. The Mean annual total of rainfall range between 1000-1500 mm. The rainfall totals decrease as one moves away from Lake Victoria shores toward the west and they fall to about 750-875 mm. The mean monthly maximum temperatures range between 26 and 27° C while the mean annual minimum temperature tend to decrease west wards from 17.5° C in the east to 15°C to the West. This could be because of altitude, which increases towards the west. Masaka and Rakai district have basically four types of vegetation ranging from thick equatorial forests, through grasslands to cultivated areas and wetlands. Gazetted forest occupy 38% of total land area of Masaka District (DPU) Both districts share portions of the Lake Victoria and have a number of rivers crossing the districts and pouring into Lake Victoria. Much of the district has both Permanent and temporally wetlands known as *embuga* cover about 20% of the districts. Lake Victoria found on the South Eastern part of the district is one of the most important resources of the district from which much of the revenue is got.

The soil texture of both districts ranges from red laterite, sandy loams to loams in different areas.

The main economic activity in both Masaka and Rakai districts is agriculture engaging 72% of the household population (MAAIF, 2000). Annual crops grown are maize, cassava. sweet potatoes, beans vegetables and groundnuts for both subsistence and commercial purposes. Perennials include various banana varieties used both for food and commercial purposes while coffee is exclusively a cash crop. Vanilla is also gradually being adopted as a cash crop. The type of livestock commonly kept by farmers include: cattle, goats, pigs and local chicken. Fishing is done from the lakes and swamps and with the present foreign market for fish it has become a lucrative business for both districts. Forestry related activities as lumbering are also common in both districts.

Data collection: Secondary data was obtained from existing records in Vi Agroforestry project offices, the Local Governments, Makerere University libraries, Ministry of Agriculture, Animals Industry and Fisheries, production departments in Rakai and Masaka district, (Ministry of Finance, 2003). Planning and Economic development and National Environment Management Authority (NEMA, 1994), Ministry of Lands, Water and Environment.

Primary data was collected using survey methodology; questionnaires were given to household heads and checklists were used in the focus group meetings. Three focus group meetings were held in each zone making a total of 6 meetings in the 2 zones. Open-ended interviews were used with non-government and government extension officers and with key informants in the area. Observation and physical counting of trees for every tenth household surveyed was done.

Surveys also sought information about household characteristics such as education levels, age, sex of the household head, decision-making structure regarding planting of trees on the farm, family size, income levels, off farm employment, farm size, fragmentation of holdings, land tenure status, extension services, other trees on the farm and their uses, proportion of the farm under tree cover and under *Calliandra* and *Sesbania* and government policies influencing adoption. Detailed questions about the time when they planted *Calliandra* and *Sasbenia*, location, management, uses and extension work were asked in the focus group meetings for triangulation.

Data analysis: To analyse household factors which influence adoption and whether the decision to be made is either to adopt or not, a logistic regression analysis (logit) was used to determine the effects of a number of household characteristics on the adoption of *Calliandra* and *Sesbania.* A logit model was chosen in this particular case because of the simple interpretation of the fitted models using odd ratios. The choice to adopt *Calliandra* and *Sesbania* as agroforestry trees or not is a discrete one. The decision is either to adopt or not to adopt. The choice variable which is also the dependent variable often is denoted as a dummy variable equivalent to one (1) for adoption or (0) not to adopt. $Y_i = 1$ if a farmer i adopts technology and $Y_i = 0$ if farmer i does not adopt a technology. The adoption dummy is then regressed against the independent variables denoted by Xi. The logit model representing choice to adopt or not is represented by; P (farmer i adopt) = F (b'x) where F (b'x) = $1/1+e^{-b'x}$ is the cumulative logistic probability distribution. The expression b'x is defined as; $b'x = b_0 + b_1x_1+b_2x_2+\ldots\ldots b_ix_i$ where by b_0 is the constant, $b_1,b_2\ldots b_i$ are the estimated coefficients and $x_1,x_2\ldots\ldots x_i$ are the values of the independent variables. The hypothesized logit model for this study is:

$$Z_{ij} = b_{i0} + b_{i1}\ r\_age + b_{i2}\ sexhhed + b_{i3}\ f\_size + b_{i4}\ gpmbr + b_{i4}\ r\_edlv + b_{i5}\ fmnsx + b_{i6}\ hedc + b_{i7}\ landtn + b_{i8}\ yrsfm + b_{i9}mjisc + b_{i10}\ iclevel + b_{i12}\ ncattle + b_{i13}\ ngoats + b_{i14}fcall + b_{i15}fsesb + b_{i15}\ fwsoce + b_{i16}\ dfrsoce + b_{i17}\ ffext + b_{i18}\ n\ ext + \ldots, i.$$

In the model above i = household (1-120) and the definitions of the dependent and independent variables are in Table 1.

Table 1: Explanatory variables and their expected signs

Variable	Description	Expected sign
St.adopt	Adopted agroforestry 0 = no 1= yes	
r_age	Age of the respondent: Categorical	-
sexhhed	Sex of head of household Female = 0, male = 1	+
f_size	Number of family members	+
gpmbr	Community group membership no = 0 yes = 1	+
r_edlv	Education level of the respondent 0= no formal education	
	1= formal educ	+
fmnsx	Sex of farm manager female=0 and male =1	+
hedc	Education level of farm manager 0 = primary or none 1 = secondary and above	+
landtn	Land tenure status 1 = title holder 0 = Kibanja (tenant) holder	+
yrsfm	Number of years spent on the farm	+
mjicsc	Major source of household income; Off-farm=0; On-farm =1	+
iclevel	Household Income levels; Categorical	+
ncattle	Number of cattle	-
ngoats	Number of goats	+
fcall	Use of *Calliandra* as fodder 0 = no, 1 = yes	+
fsesb	Use of *Sesbania* as fodder fodder 0 = no, 1 = yes	+
fwsoce	Firewood source 0 = off-farm, 1= on-farm	-
dfrsoce	Distance from firewood source	+
n ext	Frequency of extension visits	+
ff ext	Farmer to farmer extension visits 0 = no, 1= yes	+

RESULTS AND DISCUSSION

The household characteristics that were found to significantly affect the adoption of *Calliandra and Sesbania* tree species are: Source of firewood (on farm or off farm) distance from source of firewood; this was given in terms of hours, use of *Calliandra* and *Sesbania* as fodder, farmer to farmer flow of extension information, number of times of extension visits, community group membership and main source of income whether on farm or off farm (Table 2). Other factors included age, gender of household head, number of years spent on the farm, size of the farm, presence of zero grazed animals, presence of other trees on the farm also affect adoption except that the effect were not statistically significant at p = 0.05.

Both the antilog estimates and odd ratio show the likeliness of adoption.

Main sources of income: The farmers whose main source of income is off-farm are less likely (odd ratio = 0.524) to adopt the growing of *Calliandra* and *Sesbania* compared to those whose main income sources are on farm. The likelihood of adoption increases by 19% as one moves from off farm to onfarm income sources shown in Table 3.

Farmers who have farming as their main occupation and so get most of their income from sell of farm produce i.e crops and livestock make up 63% of the total population.The remaining 37% are involved in other off farm activites such as petty trading, brick making, brewing, motor cycle transport (*bodaboda*) and construction works which act as their main income source.

Farmers whose main source of income is on-farm are most likely to enhance the production alternatives available to them. Artificial fertilizers and processed livestock feed are too expensive thus only the rich farmers can afford. *Calliandra* and *Sesbania* are multipurpose fast growing nitrogen fixing trees which can enhance the nitrogen content of the soil through leaf fall and by trapping the leached nutrient at levels lower than the crop rooting zones (Buresh and Tian, 1997). *Calliandra* is also so much grown on bunds to bind the soil particles so as reduce erosion. *Calliandra* is also a nutritious fodder which enhances milk production and many farmers who are practising zero grazing are adopting it for that purpose. All these enhance the production capacities of the soil and livestock which would help the farmer increase their income.

Use of *calliandra* and *sesbania* as fodder: In Table 4 both *Calliandra* and *Sesbania* provide nutritious fodder rich in proteins, with good palatability and have high production rate of fodder (AFRENA, 2000). The trees are either lopped or pruned and the twigs are given to livestock. The woody remnants, which are hard to chew, are then used as firewood.

Calliandra is more popular as fodder as shown in Fig. 1. Farmers allocated it150 scores as compared to the 40 allocated to *Sesbania.* It is interesting to note that both adopters and non adopters use the 2 tree species as fodder, such that 56 % of adopters and 20% of non adopters use *Calliandra* while 33% of adopters and 13% of non adopters use *Sesbania* as fodder. The non adopters who use the 2 species as fodder either have very few trees or have had them for less than two years so do not qualify as adopters. Others get them either free of charge or for money from adopters.

Logit analysis show that farmers who plant *Calliandra* as fodder are about twice likely to adopt the technology compared to those who plant it for other purposes. The likelihood of adoption increases by 21.4% as one tends to plant it for fodder. However, in case of *Sesbania* the reverse is true. Farmers who plant it as fodder are less likely to adopt the technology i.e the likelihood of adoption for *Sesbania* increases by 16.8 %. if it is planted for other purposes other than fodder. Referring to Fig. 1 of uses of the two tree species, it shows that farmers prefer to plant *Sesbania* for firewood rather than for fodder. *Sesbania* though has a high protein content has the following disadvantages as a fodder plant.

Table 2: Logit model for probability of adoption of *calliandra* and *sesbania* species

Variable	Antilog of estimate (odd ratio)	Odd ratio (%)
Off farm source of income (mjicsc)	0.5244	19.1
Use of *Calliandra* as fodder (fcalli)	0.4658	21.4
Use of *Sesbania* for other fuelwood (fsasb)	0.5939	16.8
Farmer to farmer extension (ff_ exte)	0.4414	22.7
Number of extension visits (n_ext)	0.7227	13.8
Group membership(gpmbr)	0.3865	25.9
On farm or off farm firewood source (fwsoce)	0.4203	23.7
Distance from firewood source (dfrsoce)	0.2809	35.5
Land tenure status (landtn)	0.5698	17.5

Table 3: Major source of income

Source	Frequency	(%)
On farm	76	63.3
Off farm	44	36.7
total	120	100.0

Table 4: Use of *Calliandra* and *Sesbania* as fodder by adopters and non adopters

	Adopters using *calliandra*	Adopters using *sesbania*	Adopters do not use *calliandra*	Adopters do not use *sesbania*	Non adopters but use *Calliandra*	Non adopters who use *Sesbania*
Numbers	34	20	19	30	12	8
(%)	56.7	33.3	31.7	50	20	13.3

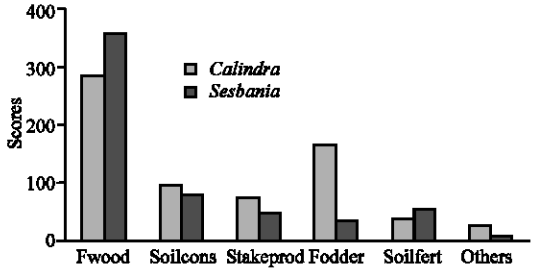

Fig. 1: Reasons for planting *calliandra* and *sesbania*

Discussion with farmers revealed that *Sesbania* is so much attacked by pests which render the leaves unsuitable for fodder. Unlike *Calliandra* with high coppicing ability after pruning or lopping, *Sesbania* will only coppice if it is young otherwise it dies and secondly its shoot does not have crown as dense as that of *Calliandra.* When comparing the two tree species with *Ficus* which is another popular tree and source of fodder *Calliandra and Sesbania* are preferred since only 16.7% of the farmers use *Ficus* as fodder compared to 38.3% who use *Calliandra* and 25% who use *Sesbania.*

Farmer to farmer flow of extension information: The logit analysis indicates that farmer to farmer flow of information increases the likelihood of adoption of the technology in question by 23%. Extension services can have an important function in speeding farmers' adoption of measures that enhance their productivity and welfare. Hence extension has the potential to increase the rate of adoption by directly increasing awareness, imparting skills and knowledge of the new technology. Farmer to farmer extension is when farmers teach each other without the involvement of the extension workers but originating from a farmer trained by the extension worker or researcher (Semana *et al*., 2001). This is quite effective because it is practical, done after testing the technology in the farmers' environment and the informal method of communication used is the most appropriate for the farmers. Out of all respondents, 41% are involved in farmer to farmer extension and 59% are not and out of all adopters 60% are involved in farmer to farmer extension services.

Frequency of visits by extension worker: Table 5 shows hyponthesized model it was assumed that the more the extension visits the higher the adoption rate. However the analysis shows that increasing the frequency of visits will enhance the likelihood of adoption by only 14%.

The simple frequency analysis reveal that extension services reach about 65.8% of the population, monthly contacts with farmers are most frequent and effective. The

Table 5: Frequency of farmer - extension agent contact

Frequency extension	Adopters (%)	Non adopters (%)	Total (%)
Weekly	23.3	15.0	19.2
Monthly	56.6	25.0	39.9
Yearly	11.0	1.6	6.7
No longer or never	8.3	45.0	27.5
No response	0.8	13.4	6.7
Total	100.00	100.0	100.0

percentage of non-adopters who no do not receive extension services is as high as 40% while it is only 8% of adopters who do not get technical guidance from extension agencies. This indicates that extension services are an important factor influencing adoption of *Calliandra calothyrsus* and *Sesbania sesban.* For every 300 household, Vi Agroforestry Project has placed an extension worker. However, areas that have low rates of adoption either are not frequented or no longer have an extension worker.

Daily or weekly visits have been found to lower the adoption rate because rural farmers in Uganda have integrated activities which are manually done. The most important being food production whereas fuel wood trees are a second priority to farmers. So daily information on the same trees tends to create a negative attitude among farmers so that they either plant some for show i.e. which they will show the daily visitor, remove even the few they have to prevent the visitor from interfering with their set programs or plant them but never adopt calling them the trees of the extension worker. Interviews with the extension workers revealed that each one of them is given a set target of number of farmers to reach every month and number of seedlings to disseminate, which at times is unrealistic for the period. This forces them to push the seedlings and seeds into farmers' hands which many times they do not plant or if they do they do not manage leading to wastage.

Targets are necessary in order to motivate the workers however these should be realistic bearing in mind the multitude of jobs a farmer has, the time it takes for an average or poor farmer whose priority is to get enough food to eat and may be some extra for sell, to go through the process of adoption. This will also help to reduce wastage of seeds and seedlings and the cost of extension.

Membership to community groups: The majority of respondents were members of one or more community groups, 63% were members while 37% were non-members. The common community group was the Vi farmers group; though a few belonged to various local credit and savings groups, *Munno mu kabi*, which are self-help and groups which were initiated by other development organisations such as Masaka Diocese Development

Organisation (MADDO), World Vision, International Credit Relief, Send a cow and YWCA. Out of the total respondents, 41% were group members and adopters, 22% were group members but non-adopters, 10% were adopters but belonged to no group while 27% were non-group members and non-adopters.

Logit analysis results show that farmers who do not belong to community groups are less adopters of the 2 tree species or the likelihood of adoption increases by 25.9% as the tendency to group membership increases. The groups are the main avenue through which extension officers deliver materials such as seeds and information about various agricultural technologies. So the only way non-group members can get these benefits is to liaise with group members. Secondly group members having a common identity tend to work together, monitoring each other and at times offering manual labour as in planting of trees. They also tend to create inter member and inter group competition which was considered health for adoption. The farmers who are adopters but non group members and made up 10% of the respondents acquired that status because through their own initiatives they acquired zero grazing livestock. They, therefore, found it necessary to plant mostly *Calliandra* for fodder through knowledge acquired from neighbours, radio and extension workers.

Source of firewood: It was found in the study area that some farmers (64%) get firewood from on farm sources, others (34%) from either the bushes or *Eucalyptus* plantations nearby and the rest buy or use charcoal. Analysis show that those with on farm source are more likely to adopt *Calliandra* and *Sesbania* than those with off farm sources of firewood. The reason for this is because as long as there are some sources of firewood near by, planting of trees becomes a non priority to many farmers.

In Masaka and Rakai there are some areas with semi-deciduous forest and grass savanna zones, with patches of Acacia thickets, which are not under cultivation (NEMA, 1994). At the same time, 24% of respondents own Eucalyptus woodlots ranging between 20 to over 1000 trees. The owners still allow the communities to collect twigs and off cuts from them. These sources encourage farmers not to plant trees for firewood. However, the landlords are becoming strict in areas such as Kalungu and are starting to refuse the people from collecting the twigs and the bush sources are also becoming scarce because of the increased demand. In future this will prompt people to adopt the tree species after the existing sources become exhausted or become inaccessible for them. Those who have on farm firewood sources would never want their sources to get exhausted so they keep on planting firewood tree species such as *Calliandra* and *Sesbania* to supplement the others they already have.

Table 6: Distance from firewood source

Distance (h)	(%)
< 1 h (including on farm sources)	80
Between 1-3 h	18
> 3 hh	2
Total	100

Table 7: Income level versus adoption in percentages

Status	High income	Average income	Low income	Totals
Adopters	16.7	20.8	12.5	50
Non-adopters	13.3	15.0	21.7	50
Totals	30	35.8	34.2	100

Distance from firewood source: Distance from firewood source was given in hours; less than an hour, between one hour and three hours and more than three hours walk. Of all the respondents 80% get their firewood within less than an hour's walk, 18% from between one hour and three hours and 2% from more than three hours (Table 6). The analysis (Table 2) show that the further away (more than an hour) the firewood source is the more likely the adoption is or the likelihood of adoption of *Calliandra* and *Sesbania* increased by 35% the further away the firewood source was.

Looking for firewood is a very tiring activity and it interferes with other development activities in the household. Society has allocated this responsibility to women and girl-children who in addition have other productive and reproductive responsibilities. To lessen the energy used the obvious thing to do is to plant the trees near the households thus increasing the rate of adoption.

Adoption of *calliandra* and *sesbania* tree species as compared to income: Household income affects adoption though at an insignificant level. When income was compared with the rate of adoption of *Calliandra* and *Sesbania,* it was seen that highest adoption occurs among average income earners, 21% of adopters belonged to this calibre. The lowest adoption was exhibited among low-income earners with 22% of non-adopters belonging to this category (Table 7).

According to CIMMYT (1993), initial adoption of agricultural technologies is highest with high-income earners and lowest with low-income earners. The difference comes because high income earners have large pieces of land so can spare some for woodlots of *Eucalyptus* or coffee in which they plant *Ficus natalensis* which is the nearest alternatives to *Calliandra* and *Sesbania*. Both *Eucalyptus and Ficus* are better income

Table 8: Age of the respondents versus adoption

Age group	Total number in the age group	Total adopters	% adopters of total in age group
< 18	7	3	42.8
Between 19-29	13	3	23.1
Between 30-39	29	18	62.1
>40	71	36	50.7

earners than *Calliandra* and *Sesbania* through the sell of *Eucalyptus* poles and firewood and barkcloth and firewood from *Ficus*. Though the rich have cows which would have prompted them to plant *Calliandra* and *Sesbania* species as fodder, only a few households 16.7% own zero grazed cows while the majority have them on free range system. Some farmers also believe that *Calliandra* is given only to exotic livestock. Average income earners have the average acrage (2.8 acres) which they have to utilize to get whatever they need. They therefore adopt agroforestry with these multipurpose trees which help to keep the soils fertile and offer other products such as fodder and firewood and services such as soil fertility and soil conservation. Poor people have very small pieces of land and they fear change so they become laggards in adoption (Rogers, 1983).

Age: Table 8 represents that the highest percentage of adopters was in the 30-39 age groups, followed by the 40 and above age group with 62% and 51%, respectively. Though fewer of the younger people were involved in the interview, the percentage of those who adopted was significantly small. CIMMYT (1993) related adoption to age in that older farmers having more experience, resources and authority were more likely to try out new technologies. However young farmers were more likely to adopt because of more schooling and planning horizons than the older farmers. Hoover and Wiitala in their study with farmers found out that age has a significant negative influence on adoption. Discussions in the focus group meetings revealed that adoption was better with older farmers because they are more settled taking farming as their major employment, they have average land sizes (2.8 acres) and own livestock which need *Calliandra* as fodder.

Younger farmers have less land for farming; they tend to be involved in other activities such as petty trading, transport (*bodaboda*) and brick making which do not give them time to adopt farming. It is noticed that as the age increases after 40 years, percentage of adopters decreases although the numbers involved in farming is high. In the study done on the adoption of grade cattle by farmers in Kenya, KARI-ILRI found out that the probability of adoption decreased by more than1% annually. Older farmers (more than 40 years) have the land but are not strong enough to manage the labour intensive *Calliandra, Sesbania* and crop agroforestry mixtures.

Table 9: Source of planting materials

Source	*Calliandra* seeds (%)	*Sesbania* seeds (%)
Vi Agroforestry Project	73.3	68.3
Own farm	3.3	5.8
Others	3.3	2.5

Table 10: Harvesting of *Calliandra calothyrsus* and *Sesbania sesban* seeds

Tree species	Household harvesting (%)	Not harvesting	No response
Calliandra	18.3	66.7	15
Sesbania	20.0	65.0	15

Source of planting material: For sustainability of adoption of trees, continuous supply of planting materials in form of seeds and seedlings is one of the pre requisites. Table 9 shows that Farmers in the study area have 3 sources of seeds and these are; Vi agroforestry project which is the main supplier (73.3 % of households depend on Vi for *Calliandra* while 68.3% depend on Vi for *Sesbania* seeds), their own farms and from other organisations which work in the area. Vi agroforestry project gives each farmer at least 200 g of *Sesbania* and 150 g of *Calliandra* seeds every season. This has created a dependence syndrome as most of the farmers including adopters do not harvest their own seeds.

When harvesting of seeds was assessed, it was found that less than 20% of all respondents bother to harvest seeds from their trees. The reasons given were, Vi project gives them more than enough seeds free of charge so they see no reason for harvesting their own. Most of them do not have knowledge of the harvesting techniques especially of *Calliandra* seeds which are highly dehiscent. *Calliandra,* which is so much used for fodder is kept low by frequent lopping so is not allowed to seed. There is no market for seeds so there is no reason for harvesting them.

Table 10 shows that Out of all respondents 18.3% harvest *Calliandra* and 20% harvest *Sesbania* seeds. The rest depend on hand outs from Vi Agroforestry project and other organizations. Out of all adopters, only 28% harvest *Calliandra* and 30% harvest *Sesbania* seeds. Presently with Vi Agroforestry Project still supplying the seeds, sources have no serious impact on adoption. However since, this is a project and it will have to come to an end, so there is need to build a sustainable supply of seed by encouraging the farmers to constantly use the sources on their farms.

CONCLUSION

There was a strong relationship between on-farm income source, frequency of extension services, use of *Calliandra* as fodder and on- farm sources of firewood and adoption. There is a weak relationship between socio-economic characteristics such as age, income levels and

farm experiences to the adoption of *Calliandra* and *Sesbania*. On the basis of the findings of this study, therefore, the role of policy makers in devising appropriate demographic and socio-economic policies to accelerate the rate of adoption appears to be important in the areas with conditions similar to those in Masaka and Rakai district, Uganda.

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REFERENCES

Arnold, J.E.M., 1997. Framing the Issues, In Farms, Trees and Farmers: Responses to Agricultural Intensification, Arnold, J.E.M. and Devees, P.A. (Eds.). Earthscan.

AFRENA- Project Uganda, 2000. Useful trees for farming: Calliandra calothyrsus. AFRENA, Kampala.

Buresh, R.J. and G. Tian, 1997. Improvement by trees in sub-Saharan Africa. Agrofores. Sys., 39: 51-56.

CIMMYT, 1993. The Adoption of Agricultural Technology: A guide for Survey Design. Mexico.

Denning, G.L., 2001. Realising the potential of Agroforestry: Integrating research and development to achieve greater impact. In: Development in Practice, Volume 11, No 4. Carfax Publishing.

Franzel, S., R. Coe, P. Cooper, F. Place and S.J. Scherr, 2001. Assessing the adoption potential of agroforestry practices in sub-saharan Africa. In: Agricultural Systems. Elsevier Sci. Ltd., 69: 37-62.

Masangano, C., 1996. Diffusion of Agroforestry Technologies Internet http//www.msu.edu/user/masangn/agrof.html.

Mugendi, D.N., P.K.R. Nair, J.N. Mugwe, M.K. O'Neill and P.L. Woomer, 1999. Alley cropping of maize with Calliandra and Leucana in the sub-humid highlands of Kenya. Part 1. Soil fertility changes and maize yield. Agrofores. Sys., 9: 39-50.

MAAIF, 2000. National Agricultural Advisory Services Programme (NAADS); Master Document of the NAADS task Force and Joint Donor Groups. Ministry of Agriculture, Animal Industries and Fisheries, Entebbe, Uganda.

Ministry of Finance, Planning and Economic Development (MFPED), 2003. Uganda Poverty Status, 2003. MFPED, Kampala.

NAS, 1980. Firewood crops, shrubs and tree species for energy production. National Academy of Sciences. Washington D.C., USA.

NEMA, 1994. National Environment Management Authority. State of environment report for Uganda. Ministrity of Water, Lands and Environment, Kampala, Uganda.

Rogers, E.M.,1983. Diffusion of Innovations. 3rd Edn. Free Press New York.

Semana, A.R., R. Percy and P. Kibwika, 2002. Sharing Experiences on Participatory Technology Development. Dept. of agricultural Extension/ Makerere University and International and Rural Development Department , the University of Reading.

UBOS, 2002. Uganda Bureau of Statistics. Uganda Population and housing Census. Provisional Results Kampala, Uganda.