Agroforestry as a solution to poverty in rural Tanzania. Lessons from Musoma Rural District, Mara Region, Tanzania

Mbwambo J.S.[2]*, Saruni, P.L*[3]*. and Massawe, G.S.*[2]

ABSTRACT

Demand for agricultural land and forest products is on increase in most developing countries such as Tanzania. This leads to shortage of arable land accelerating land degradation and hence decline in agricultural productivity. In the tropics Agroforestry (AF) technologies have been proposed as the solution of land shortage and productivity due to its great potential for both forestry and agricultural products. Despite the fact that AF interventions have been in Tanzania for many years, the pace at which AF technologies are adopted by rural people is not yet encouraging. Less adoption to the AF technologies may be attributed to inadequate knowledge and information on its importance to poverty reduction and socio-economic, services. This paper present a research results conducted in Musoma Rural District to determine relationship between tree growing effort and socio-economic factors. Qualitative and quantitative data collection and analysis techniques were adopted. It was found that majority of farmers who adopted agroforestry farming systems produced high crop yields, wood materials for fuelwood and poles as well as increased income at households' level. Based on these findings, the study recommends on strengthening the implementation of strategies for improving agriculture production, which in turn would lead to poverty reduction among rural households.

Keywords: Adoption, agroforestry, income generation, rural Tanzania

[2] Development Studies Institute, Sokoine University Agriculture.
[3] Department of Social Studies, The Mwalimu Nyerere memorial Academy

BACKGROUND

Agriculture is the main stay of the majority of rural Tanzanians. Most of these farmers however, perform their activities using traditional methods and approaches. Unfortunately, the productivity of these traditional production systems is generally low leading to low standard of living. Moreover, lack of modern knowledge of farming to farmers has been instrumental in perpetuating the low productivity of the agricultural land.

There is an annual increase of poverty in many rural areas of Tanzania, including Lake Victoria and Musoma Rural District. This is caused by most farmers' dependence on short-lived crops such as rice and maize, and lack of stable marketing price for cotton, the famous cash crop in the area. Moreover, the increase in Human and livestock population have exerted pressure on land. The consequence has been cultivation in marginal land, overgrazing, soil erosion and scarcity of woody materials (URT, 1998 and Katani, 1999). Problems of livestock production also increase yearly. These problems, among others, include acute feeds shortages caused by long and frequent droughts, diminishing grazing land due to increased cropping and shortage of herding labour (Otsyina, Asenga and Mumba, 1994).

Agroforestry, defined as a collective name for land-use systems and technologies where woody perennials are deliberately used on the same land-management units comprising agricultural crops and/or Livestock. This is done in some form of spatial arrangement or temporal sequence (Nair, 1990). In agroforestry systems there are both ecological and economical interactions between the different components. Agroforestry is frequently invoked as a solution to problems related to land degradation, low crop yields, deforestation, and scarcity of woody materials.

Although, Agroforestry has been invoked to reduce poverty among rural households, its importance and extent of adoption have not been widely understood in many rural areas of Tanzania. Agroforestry as a multipurpose land use system has been suggested as a solution to attain sustainability in land use and as a complement to the existing land use management (Senkondo, 1994). This is because agroforestry has several advantages including; control of soil erosion, conservation of soil fertility, and enhancement of biodiversity increasing income, increasing crop yields, provision of fuelwoods, fruits, fodder and building materials. Despite these potentials of agroforestry to world communities for about 1300 years now (Sanchez, 1995), it is not fully practiced in many rural areas of Tanzania.

Although efforts have been made to research on agroforestry technologies (Lulandala, Munishi and Maliondo, 1995; Otsyina *et al;* 1994, Chamshama *et al;* 1994, ICRAF, 1996 and ICRAF,1997) and many projects have been established such as; Hifadhi Ardhi Shinyanga (HASHI), Vi Agroforestry, *Hifadhi Ardhi* Dodoma (HADO), *Hifadhi Mazingiria Iringa* (HIMA) and Soil Conservation Project in Arusha(SCAPA), still the adoption process is relatively low in many parts of Tanzania. Moreover, there is now a substantial body of scientific literatures on the biophysical features and potential of Agroforestry practices. This provides a first indication of Agroforestry suitability for widespread promotion and their likely economic, social and environmental contribution. There is little information available on the adoption of Agroforestry practices or its potential for household income, food security, and welfare (Chingonikaya, Chamshama and Mugasha, 2001).

The paucity of information on the adoption and likely impact of agroforestry on poverty reduction forms a significant research challenge. This calls for need of conducting studies that determine factors that have led to low rate of agroforestry technologies adoption. In order to provide such information, the current study was conducted in rural areas around Lake Victoria, particularly in Musoma Rural District to investigate on rate of agroforestry adoption among the rural households as well as its role to household wellbeing improvement.

MATERIALS AND METHODS

The study was carried out in rural areas of Musoma Rural district in Mara Region which lies east of Lake Victoria between latitudes 1º30’ and 2º45’ South and longitudes 33º15’ and 30º39’ East. Agriculture is a dominant economic activity. The district faces a serious threat of land degradation, deforestation, declined agricultural crop productivity and shortage of feeds for livestock production (URT, 1998). Four rural villages which include Mgango, Kwibara, Tegeruka and Chumwa were randomly selected at Musoma Rural district based on the type agroforestry system practiced in the area as a mean for income generation at household level.

The target population for this study was all farmers in Musoma Rural district. The study employed a multistage sampling technique starting with district level through divisions, wards, villages to household level, the survey subjects. Simple random sampling was employed to select two divisions from the Musoma Rural District. Using the same technique, one ward from each division was selected followed by two villages from each selected ward. Reconnaissance survey was conducted in each identified village in collaboration with Vi Agroforestry Officials and village leaders were used to identify the participating households.

Sixty (60) households in each selected village were randomly selected from the list of adopters of Agroforestry technologies. The total sample size of 240 households was surveyed from four villages, close to Lake Victoria. The criteria for reaching the sample size was based on Morse (1994) and Bernard (2000) who states that interviews for most studies are based on samples between 30-60 interviews for qualitative studies.

Data were collected using an administration of questionnaire and key informant interview. In addition, extra information was gathered by interviewing the key informants such as village leaders, forest, extension and natural resource officers (most of them from Vi Agroforestry Project) were interviewed using checklist. Data were analyzed using both quantitative and qualitative methods. Descriptive statistics such as frequency tables, percentiles, and proportions were used. Multiple regressions were employed to attain inferences on the target population using sample data. Content and structural-functional analysis techniques were used to analyze qualitative data and information" (Frazel and Cherr, 2002).

RESULTS AND DISCUSSION

Adoption of agroforestry technologies

The adoption rate of agro-forestry practices was assessed by asking the farmers involved in Vi Agroforestry project whether they have they used agro-forestry technologies or not. The distribution in Table 1 shows households' extent of adoption of agroforestry technologies. The Table reveals that about 5.0%, 14.6%, 39.6%, and 40.8% of the household adopted 10, 2, 8, and 5 agroforestry technologies respectively. The majority 40.8% of the farmers adopted 5 agroforestry technologies. The average number of the technologies adopted by farmers is 4.31 (approximately 4) while average rate of adoption of agroforestry technologies is about 43.1% implying that adoptionof technologies is not satisfactory. Orisakwe and Agomuo, (2011) established that poor delivery system of the extension agents and high cost of adopting the technologies could result to low adoption rates.

Table 1: Distribution of Respondents According to number of Agroforestry Technologies adopted

Number technologies adopted	Frequency	Percent
2	35	14.6
5	98	40.8
8	95	39.6
10	12	5.0
Total	240	100.0

Average number of technologies adopted: 4.31
Average Rate of adoption: 43.1%

Adopted Agroforestry practices include home gardens (18.8%), alley intercropping (49.2%), improved fallows (18.8%), and boundary (6.7%) and scattered (6.7%) as data reveals in Table 2. It is important to note that homegardens in this study are quite different from the ones being practiced in Chagga and Haya areas (Kajembe, 1994) and (Oktin'gati and Mongi, 1986). The differences are based on diversity of plant species and storey strata. The ones reported by (Rugalema, 1994) have high diversity plant species index and storey strata compared to this study which have low plant species diversity and storey strata.

Alley cropping or hedgerow intercropping is an agroforestry practice in which perennial, preferably leguminous trees or shrubs are grown simultaneously with an arable crop. According to (Rugalema, 1994) alley cropping retains the basic restorative attributes of the bush fallow through nutrient recycling, fertility regeneration and weed suppression and combines these with arable cropping so that all processes occur concurrently on the same land, allowing the farmer to crop the land for an extended period.

There have been contradicting results on effect of land tenure on tree planting (Kang and Ghuman, 1991). For example, while Studies by (Lowry, Steinbarger and Jabbar, 1994; Mugo,1999 and Kajembe and Mwaseba 1994), have shown that insecure land tenure is either closely interrelated or contributes to limited adoption of tree planting, some studies have contradicted this finding by showing that land tenure security has nothing to do with tree planting within the communally owned land tenure system (ICRAF,1999).

The various ways in which forestry can be adaptive to make it more responsive and effective in the context of rural development have in common with the growing role of a forester as the extension agent (Kajembe and Mwaseba, 1994). In this study, extension services, which are referred to, were those provided by Vi Agroforestry Project, which has the mission of disseminating agroforestry technologies to farmers around Lake Victoria, particularly within 25kms from the lakeshore. The Vi Agroforestry project field officers become extension agents to effect agroforestry development.

The survey show that, very few farmers considered access to capital as important factor for tree farming. In smallholder farming system for example, family labour does not require huge investment in planting trees. In addition, very few farmers buy seeds and seedlings instead they have their own home backyard nurseries, using simple techniques, which do not demand market inputs such as industrial fertilisers or pesticides. Moreover, many farmers get seeds from Vi Agroforestry project.

Adoption of agroforestry practices can partly be explained by the fact that farmers consider investment in trees being less involving than in crop production. It is worth to note that farmers usually take into account whether a change in their system of production, which might improve their situation if it works, would leave them worse off if it fails. Smallholder farmers who mostly live at the margins of existence would always like to avoid any change which though it might improve their situations if it functions as expected, could leave them even worse off than they were before, if it does not (Weirsum,1984). Efforts that are being made by Vi Agroforestry project in the study area encourage the farmers to adopt agroforestry practices. Through the project mission of improving food security, availability of fuelwood and on-farm sources of incomes, the farmers have equally realised the importance of growing trees.

Table 2. Types of agroforestry practices adopted by farmers in Musoma Rural district

Type	Mgango	Kwibara	Tegeruka	Chumwi	Overall
Homegardens	24[1] (40.0)[2]	15 (25.0)	6 (10.0)	-	45 (18.8)
Alley cropping	21 (35.0)	31 (51.7)	40 (66.7)	26 (43.3)	118 (49.2)
Improved fallows	6 (10.0)	6 (10.0)	12 (20.0)	21 (35.0)	45 (18.8)
Boundary	3 (5.0)	3 (5.0)	-	10 (16.7)	16 (6.7)
Scattered	6 (10.0)	5 (8.4)	2 (3.3%)	3 (5.0)	16 (6.7)
Total	60 (100)	60 (100)	60 (100)	60 (100)	240 (100)

[1]Frequency of respondents; [2]Percetange of respondents

Benefits of agroforestry technologies

In this study, about 54% of the farmers involved in Vi Agroforestry project, had planted trees between 10 and 50 while only 7.9% planted more than 200 trees. Some of the tree species grown by the farmers and their uses are shown in Table 3. It can be seen that fuelwood and soil fertility improvement are the common uses for trees/shrubs planted in the area.

Kajembe and Luoga, (1996) found that benefits such as improved household wellbeing, soil and water conservation and farm productivity as well as availability of woody materials can influence the adoption of the agroforestry technologies by smallholder farmers. In Njombe, farmers started to adopt tree farming after observing multiple benefits that they can accrue from trees. The same observations are pointed by farmers interviewed in this study.

Pfeiffer, (1990) points out that agroforestry practices have multiple outputs and are complex agricultural systems. Thus agroforestry practices result to necessary diversity needed to improve income, food security and ecological stability particularly in subsistence farming. In this study, farmers had pointed out to receive benefits from tree farming.

Table 3. Tree/shrub species and its uses grown by farmers in Musoma Rural district

Tree/shrub species	Uses
Acacia nilotica	Improving soil fertility, poles, fuel wood, fodder
Acrocarpus fraxinifolius	Shades, poles, timber, fuelwood
Albizia lebbeck	Fuelwood, poles, soil fertility improvement,
Annona muricata	Fruits, shades, fuelwood
Azadiracta indica	Fuelwood, poles, shades
Carica papaya	Fruits
Casuariana spp	Soil fertility improvement, timber, poles, fuelwood
Cedrela odorata	Timber, poles, fuelwood, shades
Gliricidia sepium	Soil fertility improvement, poles, fodder, fuelwood
Grevelia robusta	Soil fertility improvement, timber, poles, fuelwood, fodder
Khaya anthotheca	Timber, poles, fuelwood
Leucana diversifolia	Soil fertility improvement, poles, fuelwood, poles, fodder
Markhamia lutea	Poles, fuelwood, shades
Melicia excelsa	Timber, poles, fuelwood
Melia ochinata	Timber, poles, fuelwood, shades
Moringa stenopetala	Soil fertility improvement, fruits/food, poles, fuelwood
Passiflora edulis	Poles, fuelwood, shades
Prosopis juliflora	Poles, fuelwood, soil fertility improvement
Psidium gajava	Fruits, fuelwood
Sclerocaria birrea	Poles, soil fertility improvement, fuelwood
Sesbania grandiflora	Soil fertility improvement, fodder, poles, fuelwood
Sesbania sesban	Soil fertility improvement, fodder, poles, fuelwood
Syzygium cuminii	Poles, fuelwood,
Terminalia brownii	Timber, fuelwood, poles, shades
Terminalia catappa	Timber fuelwood, poles, shades
Terminalia superba	Timber, fuelwood, poles, shades
Vitex chinensis	Fruits, poles, fuelwood, shades

Data in Table 4 presents results for the main factors influencing adoption of agroforestry practices in Musoma Rural district. When the farmers were asked to rank the main factors that influenced them to grow trees in their farms, 20% of them pointed to land in terms of ownership, accessibility and size. Others (19.6%) ranked at the first position, the availability of labour in terms of division of labour and decision-making. Other main factors that were ranked at the first position were scarcity of fuelwood (12.5%), provision of multiple benefits (11.7%), availability of extension services (15.4%), improvement of soil fertility (17.1%) and access to capital (3.8%). Planting of trees in farms due to replenishment of soil fertility observed in this study concurs with the assumption that problems leading to low land productivity have great influence to the adoption of agroforestry technologies. This indicates that farmers grow trees in farms in order to replenish soil fertility, which in turn leads to increased crop yields.

Table 4. Factors influencing adoption of agroforestry technologies in Musoma Rural districts

Factor	Mgango	Kwibara	Tegeruka	Chumwi	Overall
Land ownership	11[1] (18.3)[2]	14 (23.3)	15 (25.0)	8 (13.3)	48 (20.0)
Labour availability	12 (20.0)	9 (15.0)	13 (21.7)	13 (21.7)	47 (19.6)
Fuel wood scarcity	4 (6.7)	9 (15.0)	4 (6.7)	12 (20.0)	30 (12.5)
Multiple benefits	8 (13.3)	8 (13.3)	5 (8.3)	7 (11.7)	28 (11.7)
Extension services	9 (15.0)	8 (13.3)	11 (18.3)	9 (15.0)	37 (15.4)
Soil fertility decline	14 (23.3)	10 (16.7)	8 (13.3)	9 (15.0)	41 (17.1)
Access to capital	2 (3.3)	2 (3.3)	4 (6.7)	2 (3.3)	9 (3.8)
Total	60 (100)	60 (100)	60 (100)	60 (100)	240 (100)

[1]Frequency of respondents; [2]Percetange of respondents

The study went further to analyse relationship of tree farming and socio-economic factors such as household size, age, education level and sex of household head. Other socio-economic factors were land size and tenure, access to extension services and capital, crop yield and household income. With exception of access to capital, all the socio-economic factors were not significantly ($P > 0.05$) in explaining variation in number of trees planted by the household, but they had strong linearity with the number of trees planted (Table 5). Their VIF values were between 1.050 and 7.069.

Table 5. Relationship between tree growing efforts and socio-economic factors in Musoma Rural district (n = 240)

Socio-economic factors (Xi)	Number of trees planted (Y)			($R^2 = 0.44$)		
Factors	Beta value	Std error	T value	Sign. (F-value)	VIF	Conditions index
Constant	0.591	1.004	0.589	0.557	-	1.00
Household size	0.01	0.037	0.297	0.766	1.148	5.00
Education level	0.0028	0.097	0.029	0.977	1.139	8.072
Age of head of household	0.0087	0.006	0.315	0.753	1.050	7.366
Household head (male/female)	0.243	0.381	0.638	0.524	1.116	10.856
Land size	-0.152	0.079	-1.911	0.057	1.220	11.990
Land ownership	0.039	0.231	-0.170	0.865	1.128	13.395
Access to extension services	-0.054	0.171	-0.316	0.753	1.062	17.362
Increase income	0.292	0180	1.61	0.106	5.703	38.625
Increase crop yields	0.169	0.185	0.910	0.364	7.069	53.141
Access to capital	0.292	0.074	3.951	0.0001	1.257	14.362

The need for increasing income and crop yields was linearly correlated with the number of trees planted in households at VIF 5.703 and 7.069 with condition indices of 38.625 and 53.141 respectively. Benefits of agroforestry technologies included increasing crop yield (69.2%), increased income (38.3%), woody material for fuelwood and poles (86.7%), and food and fruits (30.0%).

Agroforestry and crop production

Agroforestry and crop production Trees/shrubs grown in agroforestry practices in the study area have similar features of nutrients recycling and nitrogen fixing. The characteristic of agroforestry practices to improve soil fertility had resulted to increase crop yields among farmers in this study. Maize yield was significantly different ($P < 0.05$) between before and after adoption of agroforestry practices among farmers as data shows in Table 6. Before farmers adopted agroforestry practices, an average maize yield per acre per cropping season ranged from 455.0 kg for Chumwi village to 490.8 kg for Mugango village with an overall average of 466.9 kg. After the adoption of agroforestry practices particularly improved fallows and alley cropping, the average maize yield per acre per cropping season was between 684.2 and 870.8 kg with the overall average maize yield of 782.5 kg.

Crop production is directly influenced by the magnitude of soil fertility if other factors are constant. Maintenance of soil fertility is a feature of most agroforestry practices. With regard to soil fertility agroforestry practices are able to ensure an adequate supply of essential mineral nutrients in the soil and are able to maintain favourable physical soil properties. Some studies have shown that nitrogen fixing trees such as *Leucaena leucocephala* are capable of fixing about 50 – 100kg ha^{-1} of nitrogen and nitrogen returned to the soil through litter fall and pruning may amount to as high as 100 – 300 kg ha^{-1} yr^{-1} of nitrogen nutrient (Young, 1989). Furthermore, a tree leaf biomass of 400 $kgha^{-1}yr^{-1}$ of dead matter has the potential of returning via litter fall to soil 80 –120, 8 – 12 and 40 – 120 $kgha^{-1}yr^{-1}$ of nitrogen, phosphorus and calcium respectively (Young, 1989).

Comparing the maize yield obtained by the farmers before and after adoption of the agroforestry practices, it is likely the households becoming well-to-do in terms of availability of maize as among the main staple food. The general observation that one can make in agroforestry and maize crop production is that agroforestry practice keeps low input costs, which can be afforded by poor resourced households. (Kaoneka, 1993) points to the maintenance of soil properties through agroforestry enhances *inter alia* the sustainability of agriculture system, which is influenced by the optimum balance between inputs and output of soil nutrients.

Table 6. Average maize crop yield in kg per acre before and after adoption of agroforestry practices among farmers in Musoma Rural district (n = 240)

Villages	Before	After	t value
Mugango	490.8 (48.1)[1]	870.8 (65.1)	12.251*
Kwibara	465.8 (47.8)	684.2 (55.7)	6.994*
Tegeruka	455.8 (43.9)	736.0 (68.6)	10.724*
Chumwi	455.0 (45.7)	839.0 (62.4)	11.804*
Overall	466.9 (23.1)	782.5 (31.7)	17.728

* Significant level at 1% 1numbers in brackets are standard errors of the means

Agroforestry and woody material production

In the study area, before Vi Agroforestry project executing its activities of dissemination of agroforestry technologies to farmers, there was a severe shortage of fuelwood. During the course of this study, at least there were 100 kg of woody materials a household could harvest from the farm. An average woody biomass a farmer could harvest in the study area was 1775.0 kg yr^{-1}as data show in Table 7. This provides an indication that the Vi agroforestry project has contributed in reducing of scarcity of fuelwoods and poles among households within the study area. Fuelwood and pole production through agroforestry practices in the study area is seen as a viable approach. This is because fuelwood and poles production through agroforestry makes provision for conservation of natural forest cover and time savings for other productive activities. The production of fuelwood in tree farming is crucial to people because over 50% of the wood removed from the world's forests is used for fuelwood and 90% of the inhabitants of developing world rely on it for domestic needs (Karki, 2001). Scarcity of fuelwood can create problems such as using agricultural residues and dung instead of using these materials to maintain the soil fertility for agricultural crops. Also fuelwood scarcity affect several aspects of family life as more time must be spent in fuelwood gathering at the expense of more productive work (FAO, 1989).

Table 7. Average woody biomass in kg farmers harvest after adoption of agroforestry practices in Musoma Rural district (n = 240)

Villages	Wood biomass (kgsyr^{-1})
Mugango	1788.3 (200.3)
Kwibara	1776.7 (215.9)
Tegeruka	1727.5 (198.8)
Chumwi	81807.5 (216.8)
Overall	1775.0 (103.4)

[1]Numbers in brackets are standard errors of the means

Agroforestry and household income

This study has revealed that households started accruing high income after adopting agroforestry practices data show in Tables 7 & 8. Statistical analysis indicates that the income earned by a household from one acre before and after adoption of agroforestry practices was significantly ($P<0.01$) different. Maize harvested from agroforestry practices was seemed to provide a household with an income ranging from Tshs 82,100/= to Tshs 104,500/= per acre per season. The income accrued through sales of maize harvested in the agroforestry systems, was observed to be highly significant ($p < 0.05$) different compared with that a household could obtain from monocropping systems (Table 8). Although income criteria of poverty when used alone may be criticised, it is recognised that people seek to increase the amount of money coming into the household. Increased income also relates to the idea of economic sustainability of the household.

The income figures presented in this study relied on the assumption that agroforestry practices were of woody-perennial plants + maize crop interactions. Further, the income figures were obtained in two ways, by asking the farmer how much they earn per year and derivative method from sales in the open market. However, these two methods are associated with errors. For example asking a farmer how much he/she earns, this depends on the ability of the farmer to remember and his/her interest to give true answers. The derivative technique is associated with the following error: crop price at the market fluctuates from season to season depending on the availability of commodities.

Table 8: Income earned by households through maize sales before and after adopting agroforestry practices in Musoma Rural district (n = 240)

Villages	Income through maize sales TShs/acre		t-value
	Before	After	
Mugango	58900 (5772.8)[1]	104500 (7811.7)	12.251*
Kwibara	55900 (5732.1)	82100 (6688.4)	6.994*
Tegeruka	54700 (5263.5)	88320 (8230.4)	6.585*
Chumwi	54600 (5482.2)	100680 (7490.8)	11.804*
Overall	56025 (2767.9)	93900 (3809.7)	17.728*

[1]Standard errors of the means *Significant difference at 1%

It was also learned in this study that woody products in terms of fuelwood and poles had contributed to household's income as data show in Table 8. An average income one household could earn from sales of the woody products was Tshs 88,750/= per year with a range of Tshs 88,833/= for Kwibara village to Tshs 90,375/= for Chumwi village (Table 9).

Flexibility of income from agroforestry is a positive feature for the rural poor (Karki,2001). Income generation can be either "lumpy" through either sales of tree products or crop products; as an opportunity for investment in building up assets; or staggered (e.g. fruit trees) which helps in making ends meet and/or fulfilling social obligations. Income accrued by households under agroforestry farming systems in the study cannot provide inference that the households are at the position to improve their well beings. Poverty reduction at household level has a number of indicators such as education status, health status, accommodation and water and sanitation. In most of the households visited in this study had these indicators at low standards. However, in the long run probably the income from agroforestry farming systems might reverse the indicators.

Table 9. Income earned by a household from tree product in Musoma Rural district (n = 240)

Villages	Income through tree product sales (Tshs)
Mugango	89417 (10013.8)[1]
Kwibara	88833 (10794.7)
Tegeruka	86375 (9938.9)
Chumwi	90375 (10842.4)
Overall	88750 (5171.2)

[1]Standards errors of the means

CONCLUSIONS AND RECOMMENDATIONS

It is clear from this study that agroforestry practices can be adopted when farmers are given support from NGOs and extension agents. The potential for agroforestry to increase maize and biomass yield and income is a testimony that agroforestry can be used for increasing income among smallholder farmers hence reducing poverty among rural dwellers. However, the study indicated that land and labour are the most limiting factors in the adoption of agroforestry in the study area. The study therefore makes the following recommendations. First enhancement of labour productivity through introduction of affordable labour saving technologies including the use of drought animals for land preparation. Second Encourage land ownership by women who are the prime practitioners of agroforestry practices in the study area. Continuous support by NGOs (in this case Vi-Agroforestry project and others) in terms of material supports (seeds/seedlings etc) and capacity building (e.g. nursery establishment and management) for farmers and extension staff.

Acknowledgements

We wish to acknowledge the Research for Poverty Alleviation (REPOA) for sponsoring this study. Many thanks should go to Vi-Agroforestry Project for facilitating activities involved in data collection. Lastly, our thanks should go to all Vi-Agroforestry Project officials, village leaders and the farmers for enabling us collect the appropriate information.

REFERENCES

Chamshama, S.A.O, Maliondo, S.M.S. and Mugasha, (1994). *Progress report for SAREC project on indigenous nitrogen fxing trees with potential for village afforestation, Tanzania*. Faculty of Forestry and Nature Conservation, Sokoine University of Agriculture.

Chingonikaya, E. E., Chamshama, S.A.O and Mugasha, A.G. (2001). Effect of twoyear-old improved fallows of leguminous shrubs on soil fertility and maize yield at Gairo in Morogoro, Tanzania. *Agroforestry Systems* (In press)

Chingonikaya, E. E.,, Mwakalobo, A.B.S., Kessy, F.L., (2003). *The Gender Role and the Future of Agroforestry Technologies in Farms of Poor Resource Farmers in Tanzania*. ECAPA/ASARECA Report. pp 79.

Commission, Dar es Salaam and Regional Commissioner's OfficeMara. Pp 199 environment effects of macro-contour line in the West Usambara mountains of Tanzania. Pp 195

FAO, (1989). *Arid zone forestry: A guide for field technicians*. Conservation guide 20. pp16.

Franzel, Z. and Cherr, J., (2002). *Trees on the Farm: Assessing the Adoption Potential of Agroforestry Practices in Africa*. International Centre for Research in Agroforestry (ICRAF), Nairobi, Kenya.

ICRAF, (1995). *Annual report 1994*. Nairobi, Kenya, pp239.

ICRAF, (1996). *Annual report 1995*. Nairobi, Kenya, pp239.

ICRAF, (1997). *Annual report 1996*. Nairobi, Kenya, pp 340.

Kajembe, G. C. and Luoga, E. J., (1996). *Socio-economic aspects of tree farming in Njombe district.* A Consultancy report to the Natural Resources Conservation and Land use Manamgnet Project (HIMA-Njombe). pp 103.

Kajembe, G.C. and Mwaseba, D., (1994). *The extension and communication programme for East Usambara Catchment Forest project*. Technical paper no 11. Forestry and Beekeeping Division, Tanzania/FINNIDA, pp 61.

Kajembe,G.C., (1994). *Indigenous Management Systems as a basis for community forestry in Tanzania. A case study of Dododma urban and Lushoto districts.* Tropical Resource Management Paper No. 6. Wageningen Agricultural University. The Netherlands. Pp 194.

Kang, B.T. and Ghuman, B.S. (1991) Alley cropping as a sustainable system. In: Moldenhauer, W.C., Hudson, N.W., Sheng, T.C. and Lee, S.W. (eds), Development of Conservation Farming on Hillslopes. Soil and Water Conservation Society,

Kaoneka, A.R.S., 1993. Land use planning and Quantitative Modelling in Tanzania.

Karki, R. A. (2001). Contribution of agroforestry to farm household income and community forestry management. MSc. dissertation. (unpublished) (site retrieved,23/9/ 2012)

Katani, J.Z., (1999). *Coping strategies against deforestation: Impact of socio-economic factors with special attention to gender based indigenous knowledge. A case study of Mwanza District*. MSc. Dissertation. Sokoine University of Agriculture, Morogoro, Tanzania.

Lawry, S., Steinbarger, D. M. and Jabbar, M.A. (1994) Land tenure and the potential for the adoption of alley farming in West Africa. *Outlook on Agriculture* 23 (3), 183-187.

Lulandala, L.L.L., Munishi, P.K.T.and Maliondo, S.M.S., (1995). Effects of spacing and management regime on *Leucaena* fodder yield and nutrient removal in alley cropping systems in Tanzania. *International Tree crop Journal* 8:129-137.

Mugo, F.W. (1999) *Effects of fuelwood demand and supply characteristics, land factors, and gender roles on tree planting and fuelwood availability in highly populated areas of rural Kenya*. PhD Thesis, Cornell University, New York, USA. pp 202.

Nair, P.K.R., (1990*). The Prospects for Agroforestry in the Tropics,*_World Bank Technical Paper.

Oktin'gati, A and Mongi, H.O. (1986). Agroforestry and the small farmers. A case study of Kilema and Kirwa Vunjo in Kilimanjaro. *The International Tree Crops Journal* 3 257-265.

Orisakwe Lambert and Agomuo Florence Ozioma (2011): "Adoption of Improved Agroforestry Technologies among Contact Farmers in Imo State, Nigeria" Vol. 2, No. 1, pp. 1-9

Otsyina R., Asenga D. and Mumba M., (1994). *Annual progress report*. Tanzania/ICRAF Project Shinyanga. Unpublished. pp 49.

Pfeiffer, R., (1990). Sustainable agriculture in practice-the production potential and the environment effects of macro-contour line in the West Usambara mountains of Tanzania. Pp 195

Rugalema, G. H., (1994). The sustainability of homegarden agroforestry systems: Case of Bukoba district, north -western Tanzania. *In*: Hatibu et al (eds) *Sustainable Agriculture and Conservation of The Environment Proceedings*, Sokoine university of Agriculture Convocation workshop held July 26-27th 1994, Morogoro, Tanzania pp 199 – 210.

Sanchez, P.A. (1995). Science in Agroforestry. *Agroforestry Systems* 30 5-55.

Senkondo, E. M. M. (1994). *Planning Optimal Agroforestry Strategies for smallholderfarmers in Uluguru Mountains Area, Morogoro, Tanzania*. In: Proceedings of Sokoine University of Agriculture Convocation First Workshop held on July 26-27, 1994 in Morogoro, Tanzania. pp 93-101 no. 131. Washington, D.C, USA: The World Bank.

URT, (1998). *Mara region socio-economic profile*. Joint publication by the Planning Commision.

Wiersum, K.F., (1984) Developing strategies for social forestry: A conceptual framework. Working paper, Environment and policy Institute, East-West Center, Honolulu Hawaii, USA. withparticular reference to agriculture and deforestation, some theoretical aspects and a case from West Usambara Mountains. Doctor Scientanum thesis. Agricultural university of Norway.

Young, A. (1989). *Agroforestry for Soil Conservation*. CAB International. ICRAF Nairobi pp276.