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Socio-Economic Factors Affecting Farmers' Decisions to Adopt Agro-silviculture in Turbo Division, Uasin Gishu County, Kenya

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Abstract
This study was carried out to determine the socio-economic factors affecting farmers' decisions to adopt agro-silviculture in Turbo division, Uasin Gishu County. The study was conducted in four locations of Turbo division namely Sugoi, Tapsagoi, Kaptebee and Sosiani. The specific objectives of the study were to identify the socio - economical factors that affect adoption of agro-silviculture by farmers; to establish the effects of agro-silviculture on livelihood status of farmers; and to determine levels of awareness by farmers in implementation of agro-forestry projects. The study was based on a sample size of 160 farmer respondents from the four locations in the study area. Simple random sampling technique was used to select respondents. Both primary and secondary methods of data collection were used. Qualitative and quantitative data analysis procedures were used in analyzing the data. Quantitative data was analyzed using statistical package for social scientist, whereas qualitative data was cleaned and sorted according to the themes of the research. The significance of the study is that it will provide information for policy makers and the key government departments to enhance the adoption of agro-silviculture in Turbo division and other parts of Kenya. The results of the study revealed that farmers' adoption of agro-silviculture system is significantly affected by the age, gender, farmers' level of education, contact with extension staff, level of awareness and participation in agro-forestry projects. Most farmers' sale tree products from their farms to get income for meeting other household needs. This indicates that farmers increase their resource base hence improve their livelihoods. Problems encountered by farmers towards adoption of agro-silviculture include; lack of money to buy tree seedlings and selection of types of trees that are compatible with crops. The study recommends more training and sensitization on agro-silviculture to be done by agricultural extension staff to farmers in Turbo division. In addition, the Kenya government and their development partners should channel more funding and incentives directly to farmers who have adopted agro-silviculture and develop farmer schools in the region.

Keywords: agro-forestry, community forestry, climate change effects, technology and livelihoods.

INTRODUCTION

Kenya's population has continued to increase rapidly, creating an additional one million people every year. This increase is exerting stress and pressure on existing natural resources including land. It is therefore, important to intensify production on the available scarce land in order to prepare agriculture to contribute effectively to the economy and sustain livelihoods. This has increased the use of appropriate technology, proper land use management and conservation of soil and water resources. Currently, agro-forestry is receiving more attention from government and development organizations around the world. They have identified the potential for agro-forestry in addressing several environmental and developmental problems (ICRAF, 2003).

The adoption of agro-forestry is affected by several factors such as: the biophysical characteristics of technology; individual and household characteristics of farmers; policies; and institutional context within which the technology is disseminated, (Muneer, 2008). The three major components of agro-forestry systems are: crops, trees and animals and depending upon these combinations the major forms are; Agro-silviculture, Silvo-pastoral and Agro-silvopastoral systems, (Nair, 1990). Nair (1993) note the term agro-silviculture is used to denote the combination of trees and crops such as cultivation of maize, cassava, or plantains between timber tree species or coconut or palm trees, hedgerow inter-cropping, multipurpose trees on crop land, plantation crop combinations, home gardens, trees in soil conservation and reclamation, shelterbelts, windbreaks, live hedges and fuel wood production.

Ekisa (2000) notes that Teso District like other places in the tropics is faced with environmental problems such as shortage of wood fuel, soil erosion, climate change and reduced tree based products and that all these could be solved through afforestation and agro-forestry activities.

The practice of planting useful trees and shrubs together with crops on the same piece of land for domestic use and sale has not been adopted by most farmers in Turbo division to a level that could make households self-reliant and sustainable, yet this form of agro-forestry land use system has the potential of maximizing productivity and sustainability of land as well as increasing resource base of farmers and their households. The situation is heightened by the fact that most farmers focus on large-scale crop production of maize and wheat for commercial purpose. Examples of useful trees and shrubs that are compatible with crops and were focused on during the study are *Grevillea robusta, Casuarina equisetifolia, Calliandra calothyrus, Leucaena leucocephala* and *Sesbania sesban*.

The challenge is farmers have planted several types of trees and shrubs on their farms without considering the recommended spacing, compatibility to crops and importance or harmful effects to the environment. Thus the need to research and suggest recommendations from the findings to improve farmers' adoption of agro-silviculture in Turbo division. The objectives of the study are: to identify social- economic factors that affect adoption of agro-silviculture by farmers; to establish the effects of agro-silviculture on livelihood status of farmers and to determine levels of awareness by farmers in implementation of agro-forestry projects.

Agro-silviculture is important in: environmental protection through enhanced vegetation cover that lead to formation of rainfall; absorption of excess carbon dioxide in the atmosphere that may contribute to global warming; restoration and rehabilitation of degraded land; maintaining soil fertility through control of soil erosion; nitrogen fixation by leguminous trees; source of income to farmers through sale of tree products; enhance aesthetic value of landscapes; labour-saving in fetching wood fuel as well as source of food and fodder. The study utilized three theories namely; Diffusion of Innovations theory (Rogers 1995), the Social Learning theory (Bandura 1977, as quoted in Glasser 2007) and Sustainable Resource Use theory (Walter 1965, as quoted in Turner 1988, and Wiesmann 1998).

The study is limited to households who practiced crop and tree planting on their farms. There was ethnic diversity hence a language barrier that was solved by using research assistants who are fluent in English and local languages. The significance of the study is that it will provide information for policy makers and the key government departments to enhance the adoption of agro-silviculture in Turbo division and other parts of Kenya.

Vegetation found in the Turbo division is diverse comprising mainly blue gum *(Eucalyptus spp.)*, Mexican cypress *(Cupressus lusitanica)*, black wattle (*Acacia mearnsii)*, fruit trees, shrubs and indigenous trees. The dominant vegetation cover comprises invasive trees and shrubs such as and tick berry (*Lantana camara*) and guava *(Psidium guajava*) respectively, (GoK, DDP 2008).

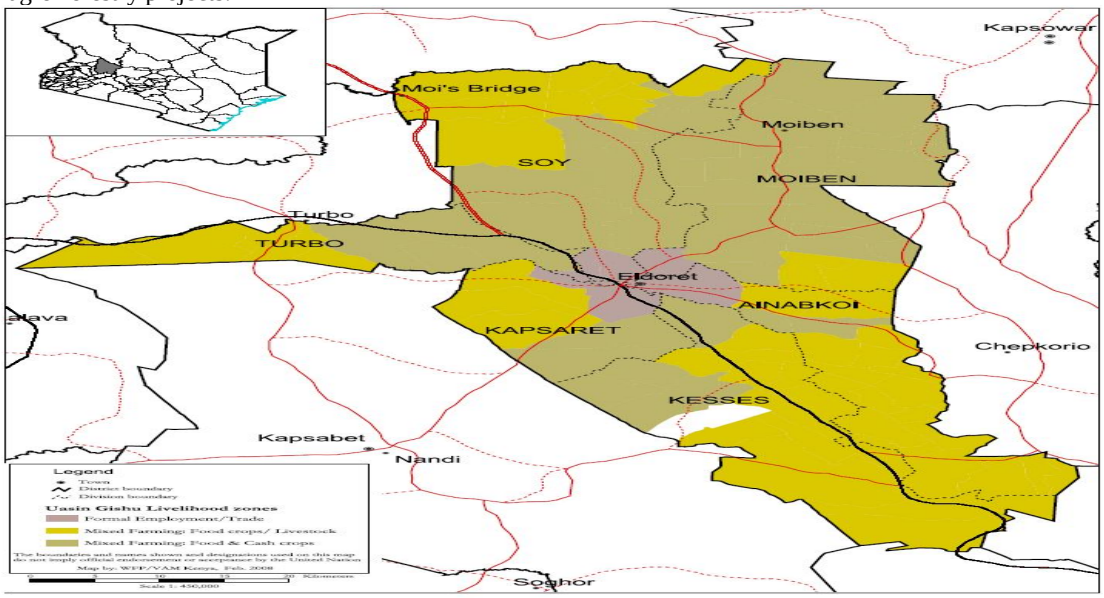

Figure 1.0: Map of Uasin Gishu District showing location of Turbo Division (researcher 2010).

METHODS AND MATERIALS

This is a survey type research carried out in four locations out of seven in Turbo division namely; Kaptebee, Tapsagoi, Sugoi, and sosiani. These were selected randomly from the accessible locations. The study was based on a total of 827 registered households living in the four locations of Turbo division. Household heads were targeted to respondents. The total sample size was determined using Kothari (1999) formula:

$$n = Z^2 N\sigma_p^2/(N-1)e^2 + Z^2\sigma_p^2$$

$$n = (1.96)^2 \times 248 \times (1.08)^2 / (248-1)\ (0.1)^2 + (1.96)^2\ (1.08)^2$$

$$n = 1111.2489 / 6.9508$$

$$n = 159.873 \quad n = 160$$

A total of 160 households informed this study from the four locations distributed proportionately to each location population. These household were expected to be practicing agro-silviculture in their farms. The head of the household was the respondent or their spouse or senior boy or girl above the age of 18 years old. Simple random sampling technique was used to sample respondents from the selected sample size in every location. Each household was assigned a number that corresponded to the plot number, and then a table of random numbers was used to obtain the 160 respondents (table 1.0).

Table 1.0: Proportional stratified random sampling design

Location	Number of households	Size (30%)	Proportion	Percentage (%)	Sample size (n)
Kaptebee	247	74	0.2984	29.84	48
Tapsagoi	223	67	0.2702	27.02	43
Sugoi	187	56	0.2258	22.58	36
Sosiani	170	51	0.2056	20.56	33
Total	827	248	1.0000	100.00	160

Source: Researcher 2010

Both primary and secondary data collection instruments were used during the study. Primary data was obtained using structured questionnaires, interviews, and direct observations. A detailed pretest of the questionnaire was carried out on similar respondents outside the target population. Appropriate amendments were then made to ensure validity, reliability and effectiveness of the research data. After collecting data from the field, quantitative data was cleaned, coded, entered into statistical package for social science (SPSS) version 17 then analyzed. Qualitative data was organized according to the research themes. Data is presented descriptively and using frequencies and percentages.

RESULTS AND DISCUSSION

Demographic Characteristics of the Respondents in Turbo division

The household heads interviewed in this study shows 79% are fathers, 19% are mothers while sons and daughters comprised only 2% of the respondents. This indicates majority of household heads are fathers, hence the responsibility to make decisions on adoption of agro-silviculture practices on the farms. This agree with studies by Ogunsumi (2007) on the socio-economic conditions of peasant farmers in Southwest Nigeria, that showed majority of the respondents interviewed were male household heads, thus decisions on agriculture activities were influenced by the head. The findings also relate to Iwueke (2006) on farmer related factors influencing the adoption of agricultural innovations in Imo, showing peer group decisions. The age of the household heads were varied as; those aged between 31-40 years were 40.6%, above 50 years of age comprised 16.3%, while those aged below 20 years comprised 1.9%. This shows that majority of the household heads were aged between 31-41 years. This implies the respondents were young and energetic and could actively participate in crop farming and tree planting. These results suggest that younger farmers are more likely to adopt agro-forestry than old farmers. According to Rogers (1995) diffusion of innovations theory, this represents a good ground for the success of extension campaigns and programs that aim at dissemination and adoption of new agricultural innovations, particularly those intended for environment conservation and natural resource sustainable management.

This study established that 79% of the household heads were male-headed households, while female-headed households comprised of 20%. This indicates that there was gender disparity within the household heads. Boateng (2008) in his study on impacts of agro-forestry on livelihoods of rural farming households in Ghana noted that majority of respondents (70%) were married male while 20% were female. The high percentages of married headed families observed in this study suggested that participation of farmers in improved fallow in the study area depended on the perception of the technology by the male members of the community because most of the women did not own land. Adesina *et al*. (2001) on econometric analysis of the determinants of adoption of alley farming by farmers in the forest zone of southwest Cameroon showed that gender played a role in decision making when it came to the adoption of new agro-forestry technologies.

The education levels of the household heads were varied as summarized in table 1.1. Studies by Njoku (1991) indicated that the level of technology adoption on smallholder farms was influenced by the farmer's age, literacy level, access to material inputs of technology and food security needs.

Table 1.1: Education levels of the Respondents

Education characteristics		Frequency	Percentage (%)
Education levels	None	10	6.3
	Primary	71	44.4
	Secondary	44	27.5
	College	26	16.3
	University	5	3.1
	Adult education	4	2.5
	Total	160	100.0

Source: Researcher, 2010

Livelihood Status of Farmers in Turbo Division

Respondents noted that they utilized tree products in different ways as summarized in Table 1.2. Results indicate that most farmers sold tree products obtained from their farms in exchange for income. Most farmers utilized income obtained from sale of tree products to pay school/college fees for their children (43.8%). There is improved change in income level of farmers before and after adoption of agro-silviculture; 74.3% had increased change in income level after adopting agro-silviculture. This positive impact on farmers helps them meet household needs such as medical bills and paying school/college fees. The results show a significant impact on farmers' adoption of agro-silviculture on their livelihood status. These agree with Mawanda (2004) who notes the revenue from farm products for most households in Uganda had increased by 73% over the last four years.

Table 1.2: Livelihood characteristics of farmers involved in tree planting

Characteristics of farmers involved in Tree Planting	Frequency	Percentage (%)
How farmers utilize tree products obtained from their farms		
Sale as timber/charcoal	70	43.8
Domestic use as firewood/charcoal	43	26.9
Construction purposes	47	29.4
Total	160	100.0
How farmers utilize income from sale of crop produce and tree products		
Pay school fees	70	43.8
Capital for business	15	9.4
Farming operations - ploughing land	36	22.5
Buying farm inputs	35	21.9
Savings for future use	4	2.5
Total	160	100.0
Change in income before and after adoption of agro-silviculture		
Increased income	118	74.3
Decreased income	34	21.4
No change in income	8	4.3
Total	160	100.0

Source: Researcher 2010

Awareness And Participation By Farmers In Agro-Silviculture Practices

The sources of information for farmers to enable them participate in crop growing and tree planting are varied as shown in table 1.3. Data shows 85.6% of the farmers obtained information through the radio, 69.4% of the farmers obtained information through newspapers while 55.6% obtained information from fellow farmers. It should be noted that these are multiple responses thus farmers obtained information from several sources.

The findings indicate that the level of contact between farmers and extension officers was low. This is because 79.4% and 93.8% show that farmers did not get information from agricultural and forest extension officers. Moreover, agricultural extension programs that aim at enhancing adoption of environment conservation innovations usually place great emphasis on raising the target population level of environmental awareness as a key factor for realizing its' objectives, (Muneer, 2008).

Table 1.3: Sources of Information to Farmers

Source of Information to Farmers	Frequency		Percentage (%)	
Resource Persons	*Yes*	*No*	*Yes*	*No*
Agricultural extension officers	33	127	20.6	79.4
Forestry extension officers	10	150	6.2	93.8
Fellow Farmers	89	71	55.6	44.4
Farmers field days	74	86	46.3	53.8
ASK shows	51	109	31.9	68.1
Indigenous knowledge informers	45	115	28.1	71.9
Print media	*Yes*	*No*	*Yes*	*No*
News papers	111	49	69.4	30.6
Posters	39	121	24.4	75.6
Magazines	32	128	20.0	80.0
Journals	11	149	6.9	93.1
Electronic media	*Yes*	*No*	*Yes*	*No*
Radio	137	23	85.6	14.4
Television	66	94	41.3	58.8
Internet	8	152	5.0	95.5

Participation by Farmers in Agro-forestry Programmes

The membership and participation of farmers in tree planting committees or projects in Turbo division are varied as shown in table 1.4. Farmers who were members of tree planting committees and projects were 19.4%, while those farmers who are not members comprised 80.6%. This indicates that most farmers in Turbo division were neither members in tree planting committees nor participated in tree planting projects thus, the level of participation by farmers in agro-forestry programmes in Turbo division is low. These finding agree with Ng`oriareng (2005) on factors hindering afforestation approaches in West Pokot District noted that specific social factors related to local community were hindering afforestation programmes. Those factors noted were level of awareness in tree planting, level of participation in tree planting and identification with afforestation programs.

Tree seedlings planted by farmers in Turbo division were obtained from various sources as shown in table 1.4; whereby 55% of them purchased seedlings. Types of trees planted by farmers in crop land are: 60% Eucalyptus trees in their farms; 19.4% farmers planted Cypress trees, while 13.1% planted Grevillea trees. Types of crops planted by farmers in include; maize (59.4%), wheat (18.8%) and other crops accounted (12.4%). The lengths of time that farmers have participated in agro-silviculture shows duration of 1-5 years comprised 43.8% while those with 6-20 years were 32.5%.

Table 1.4: Sources and types of trees/crops planted by Farmers in Turbo division

Sources & types of trees/crops planted by farmers		Frequency	Percentage %
Sources of tree seedlings	Own nursery	42	26.3
	Purchased	88	55.0
	Donations	5	3.1
	Other sources	2	1.3
	Lack seedlings	23	14.4
Type of trees planted by farmers	Gravillea	21	13.1
	Cypruss	31	19.4
	Eucalyptus	96	60.0
	Indigenous trees	12	7.5
Type of crops planted by farmers	Maize	95	59.4
	Beans	15	9.4
	Wheat	30	18.8
	Other crops	20	12.4
Duration of participating in agro-silviculture	< than 1 year	33	20.6
	1-5 years	70	43.8
	6-20 years	52	32.5
	> 20 years	5	3.1

Source: Researcher 2010

Problems Faced by Farmers in Agro-Silviculture

The farmers identified various problems they faced when deciding to participate in agro- silviculture. The results show 56.2% of the farmers had problems in choosing the type of trees that grew well with crops, 67.5% of them lack income to buy tree seedlings while 67.5% identified lack of tree seedlings. Other problems identified include; not allowed to plant trees, correct spacing of tree seedlings, do not know how to plant seeds correctly, and lack of time to plant trees. Studies by Franzel *et al.* (2002) on assessing the adoption potential of improved fallows in eastern Zambia noted a major constraint of agro-forestry adoption is the perception that trees compete with agricultural crops for land particularly when the size of holding is small. This perception is not true for Turbo division, because the size of farmer holding is large enough to accommodate both agricultural crops and trees. In addition these findings deviate from Ekisa (2000) who noted that some hindrances to successful tree planting in Teso district is the existence of taboos and beliefs attached to certain tree species and enormous duties of women were significant bottlenecks to community participation in tree planting.

The perceived changes in climate witnessed by farmers in Turbo division for the past five years indicate increased annual temperature, pest infestation, crops resistance to pesticides and soil erosion. Despite increase in amount of rainfall received annually, farmers reported decrease in land cover vegetation. This indicates that most farmers in Turbo division had observed changes in climate and climate-related factors hence, the need to introduce climate change adaptation mechanisms to cope with adverse effects of on agro-silviculture. Farmers with greatest experience of farming are more likely to have noticed change in climatic factors. Statistical tests also revealed significant spatial clustering in the proportion of farmers claiming to have observed particular forms of climate change. Unfortunately evidence about whether farmers' perceptions of climate change tally with records from weather monitoring stations was somewhat equivocal. In many cases, available climate records were shorter than the memories of the farmers themselves.

The strategies adapted by farmers in to cope with adverse effects of climate change on agro-silviculture are shown in table 1.5. Data shows 64.4% of the farmers adopted the strategy by changing the crop and tree variety planted from use of indigenous to hybrid varieties. Some 64.4% have constructed water harvesting structures such as ponds and dams, whereas 67.5% have planted different variety of trees on their farms for shade and windbreaks. According to a survey by Maddison (2007), on the perception and adaptation to climate change in Africa; most farmers' respondent by planting different varieties of the same crop and changing planting dates of crops.

Table 1.5: Strategies adapted by farmers to cope with climate changes

Strategies adapted by Farmers	Frequency		Percent (%)	
	Yes	No	Yes	No
Change maize crop variety planted	103	57	64.4	35.6
Construct water harvesting and storage structures	36	124	22.5	77.5
Construct soil conservation structures	103	57	64.4	35.6
Plant variety of trees for shade	108	52	67.5	32.5
Irrigate crops/water tree seedlings	48	112	30.0	70.0
Lease your land	25	135	15.6	84.4
Change planting date of maize crop	87	73	54.4	45.6
Change from crop growing to livestock rearing	13	147	8.1	91.9
Change from crop growing to tree planting	19	141	11.9	88.1

Source: Researcher 2010

To enhance adoption of agro-silviculture practices in Turbo division and in Kenya; the study noted that most farmers obtained tree seedlings through purchasing. Therefore, there is need for the government and stakeholders to channel funding to crop farming, tree growing and environmental conservation directly to farmers. Funding should be associated with incentives such as provision of free tree seedlings and hybrid seeds and fertilizers for farmers to establish individual or group nurseries. This will eventually motivate farmers to adopt agro-silviculture practices on their farms.

Farmers' level of awareness and participation in implementation of agro-forestry projects and programs in Turbo division is very low. In addition, it was noted that the practice of planting useful trees together with crops on the same piece of land was not clearly known to farmers, since most of them were not involved in tree planting committees and programs conducted in the area. The study recommends that agro-forestry projects be established in the four locations of Turbo division in order to create awareness on importance of participating in tree planting.

Intensive training and sensitization on adoption of agro-silviculture as a modern agro-forestry technology should be done by the Ministry of Agriculture, Ministry of Environment and Mineral Resources and Ministry of Forestry and Wildlife through agricultural and forestry extension staff. For this to be fully achieved they should integrate farmer schools whereby farmers learn from each other and quickly adopt new technology. Farmers should be sensitized on the potential impacts of agro-silviculture in climate change adaptation and income generating for their households. In terms of policy implications, it is recommended that improved farmer education would hasten adaptation to adverse effects of climate change using agro-silviculture.

CONCLUSION

Farmers' decisions to adopt agro-silviculture practices in Turbo division is significantly affected by age of the farmers, gender, level of formal education and contact with agricultural extension staff. Farmers who had adopted agro-silviculture practices in their farms had an increased income level and improved livelihood status. This shows that adoption of agro-silviculture enables farmers to improve their household food security, increase their resource base through the income earned from sale of crop produce and tree products, hence improvement in their livelihood status. The farmers seldom participate in implementation of agro-forestry projects and programmes in the division. There is need for intensive training of farmers by the relevant ministries to enhance quick adoption of agro-silviculture for household income enhancement and coping with climate change factors.

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