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Full Length Research Paper

Agroforestry trees in Kapsaret, Kenya: Socio-economic perspectives influencing availability, preference and utilization

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Majority of rural communities worldwide depend on natural resources for their livelihoods. This study examined how socio-economic perspectives influence the availability, preference and utilization of agroforestry trees in Kapsaret sub-county, Kenya. A sample of 120 farmers were interviewed on demographic trends, tree cover, tree availability, species preferences, benefits and utilization on a scale of 1 (strongly disagree) to 5 (strongly agree). Sixty-two percent (62%) of the respondents were females, 50% being over the age of 50 years suggesting a shift in societal norms with women taking over farm management roles. Over 85% of the respondents had various levels of education, indicating a high literacy level therefore ease of adoption of agroforestry practices and technologies in Kapsaret. Seventeen major multipurpose tree species were identified on the farms. *Eucalyptus grandis* was the ddominant and most preferred species (84.2% in 96 households) due to its diverse products and services. Trees on farms are utilized for fodder (10%), soil fertility improvement (47%), timber and fuel wood (77%). Over 50% of respondents strongly agreed that trees on farms improve tree cover and co-exist with food crops hence substitute for income. Labour, level of education, household security, gender, land and tree tenure and availability of information strongly influenced, utilization, species preference and availability of trees in Kapsaret. Market access and farm size was not considered as important factors. Put together these results indicate a strong association between socioeconomic perspectives and availability of trees on farms than with their utilization, hence the need to promote agroforestry technologies and practices in Kapsaret.

Keywords: Agroforestry trees, socioeconomic, perspectives, species preference, utilization.

INTRODUCTION

One of the eight Millennium Development Goals (MDGs), to which world leaders committed themselves in 2000, was to half extreme hunger and poverty by 2015 (UN Millennium Project, 2003). This would be achieved through different approaches including prudent exploitation of natural resources both on farms and in gazetted landscapes. In this regard, the potential benefits of trees for both poverty alleviation and provision of

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environmental services has been recognized (Tewari, 2008). Trees provide products such as fuel wood, fodder, timber, poles and soil mulch as well as services such as soil conservation, land demarcation, cultural rights and mitigation of climate change effects, among others (Masozera and Alavalapati, 2004). Incorporation of appropriate tree species in agroforestry land use systems provides an opportunity for subsistence farmers to reduce poverty, enhance food and nutritional security, human health and environmental sustainability (Garrity, 2004; Tewari, 2008). In this way, agroforestry tree domestication is seen as an important component of strategies to achieve the MDGs (Garrity, 2004; Tewari, 2008)).

However, these tree benefits change as household situations change and are influenced by availability of land, labour, types of trees available, techniques and risks involved in tree growing, guaranteed benefits and markets for tree products (Tewari, 2008). In an agroforestry system, household characteristics, exogenous economic forces and biophysical factors interact in a complex way resulting in highly diverse, mixed smallholder agriculture systems (Shepherd and Soule, 1998). In Kenya, many smallholder farmers own a diversity of tree species on their farms, however, their products and services are sometimes poorly managed, barely recognized, inadequately appreciated and underinvested. Studies in other parts of the world have shown that the management and utilization of tree resources by individuals, households and communities are characterized by their socio-economic, cultural, political and institutional perspectives and constraints, which ultimately control their access to and rights over these resources (Masozera and Alavalapati, 2004).

From literature studies it is evident that despite the enormous benefits of trees on farms, little is known about the social and economic perspectives that influence their preference, utilization and availability. This study, therefore, focused on describing the socio-economic perspectives of agroforestry trees, availability, utilization and preferences in households and how they contributed to economic livelihoods in Kapsaret Sub-county, Uasin Gishu County, Kenya.

MATERIALS AND METHODS

Study Area

This study was conducted in Kapsaret Sub–County of Uasin Gishu County, Kenya. The Sub-County measures 750km^2 and represents one of the six Sub-Counties of Uasin Gishu County (Figure I). The study area lies on a 1680m to 2980m above sea level (a.s.l) plateau in the Mid-West of Kenya's Rift Valley, 330km North West of Nairobi. It receives 624.9mm-1560.4mm of rainfall evenly distributed throughout the year. Air temperatures range between 7^{o}Cand 29^{o}C (a mean of 18^{o}C), hence ideal for both livestock and crop farming (Busienei, 1991). Soils are mainly red-brown loam, while vegetation ranges from open grassland with scattered acacia trees, to natural highland forests and bush land. It has three Agro-Ecological Zones (AEZ) (lower highland-LH, upper highland-UH and upper midland-UM). The study area has a total human population of 257,157 and a population density of 362/km^{2}with 42,000 households (Busienei, 1991). There are 29,802 hectares of gazetted forests (Nabkoi, Timboroa, Kipkurere, Lorenge, Cengalo, and Kapsaret) out of which 13,184 hectares (44%) is under plantation, while 16,618 (56%) is under indigenous forest cover.

Sampling and Selection of Respondents

This research was guided by a sustainable livelihoods framework (Carney, 1998; DFID, 1999). One hundred and twenty (120) farmers were selected for the study using a list of agroforestry farmers kept in agricultural and forestry extension offices at the Kapsaret Sub-County headquarters. The sampled farmers had been practicing agroforestry for at least two years and were the heads of their households. Interviews were held at their homes from July 2013 to September 2013 using a pre-tested questionnaire. One agricultural extension officer and one forestry extension officer were also interviewed. In situations where farmers were not able to understand English, the interviews were conducted in the farmers' local language. Key local informants and extension staff from the Ministry of Agriculture provided logistical support to access the selected farms. Appointments and consent for interviews were sought from prospective interviewees with the purpose and benefits of the study explained prior to the actual exercise.

Tree Species Preferences, Utilization and Availability

A total enumeration of all the existing trees within the sampled farms was done. Information on the trees' availability, utilization and preferences by farmer were recorded according to Beentje (1994) in a pre-tested structured questionnaire. Pictures were taken and

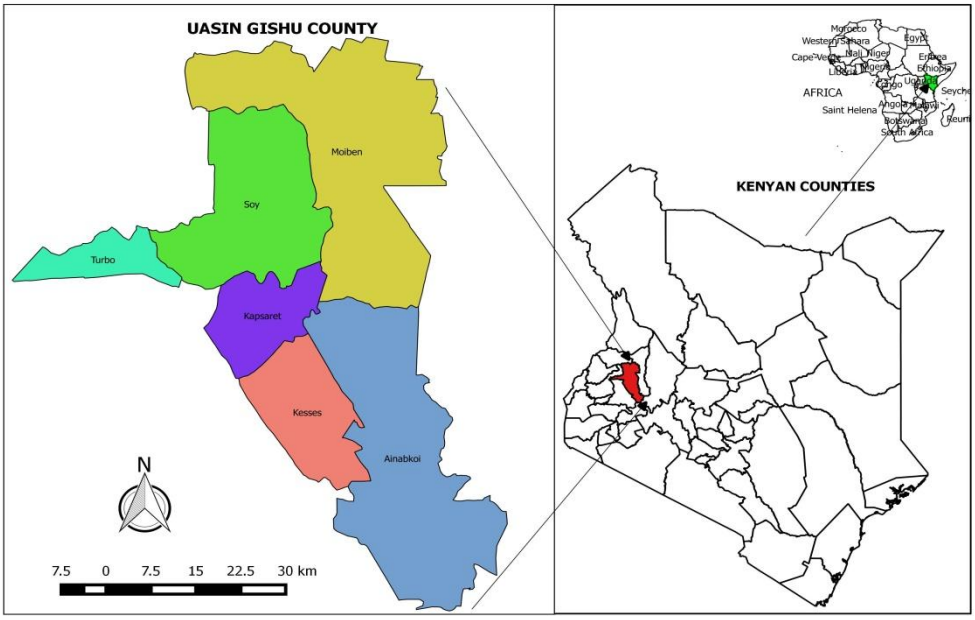

Figure I. Map of Study Area

informal discussions held. Information on cover, preference utilization and availability of agroforestry trees was gathered and ranked according to farmers' consensus in a scale of 1 to 5 as strongly agree (5), agree (4), undecided (3), disagree (2), strongly disagree (1). In addition, all products and services provided by the tree species to the farming household were evaluated.

Socio-Economic Perspectives

Structured questionnaires were used to get information from the respondents on the socio-economic perspectives: gender, education, labour, household security, land tenure, farm size, market access, information and training. The respondents were expected to rank to the extent to which they agreed as strongly agree (5), agree (4), undecided (3), disagree (2), strongly disagree (1).

RESULTS AND DISCUSSION

Age, Gender and Education Level of Respondents

Figure II shows the age and education levels of the respondents. Majority of the respondents (37.7%) were in the age brackets of 41-50 years while 13.2% were youths aged 21-30 years. These ratios were similar to those obtained for the sub-county from the 2009 Kenya National Population census. This age structure indicate a situation where there are more adult members in households meaning that more quality labour would be available for planting and domestication of agroforestry trees (Villano and Fleming, 2004). Labour from the majority of household members who fall in lower age brackets is restricted because these groups spend most of their time studying in schools and colleges. These age brackets are also expected to comprise a knowledgeable population that would be an asset to the advancement of agroforestry practices on farms. According to Olujide and Oladele (2011), age is significantly related to the knowledge of agroforestry.

According to the study, 37.7% of the respondents were male, while 62.3% were female. This is contrary to expectations in some communities where majority of respondents would be expected to be male because more often than not, men are usually heads of their families. However, the findings indicate how societal norms may have changed in recent years, such that women in Kapsaret have started taking over management

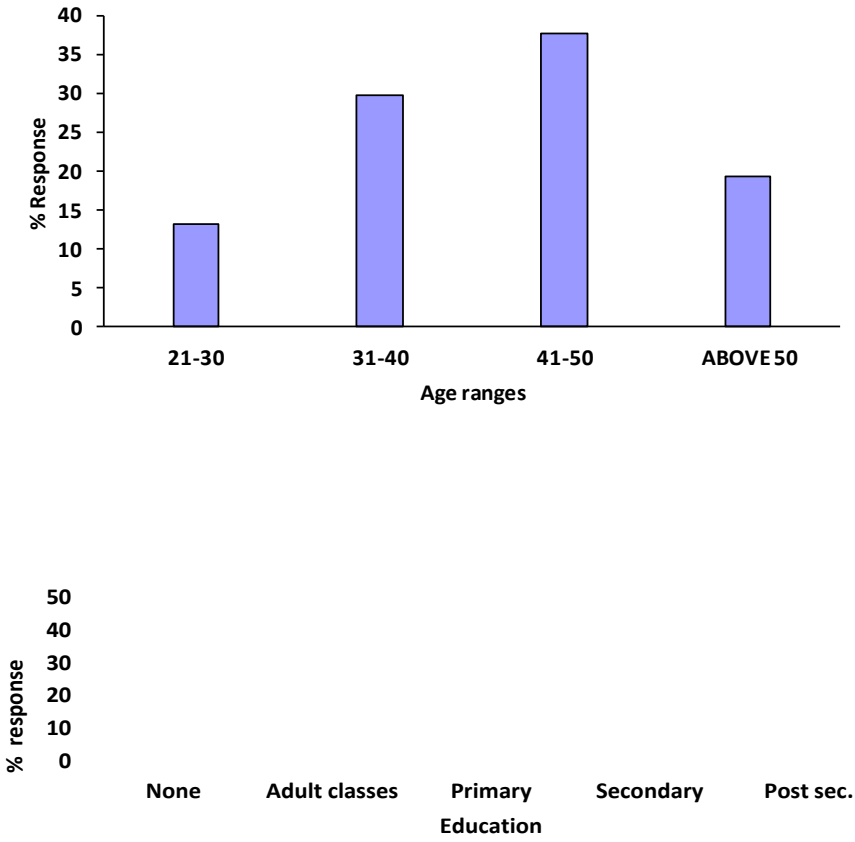

Figure II. Age and Education Level of the Respondents.

roles of some of the farm activities from men. It might also indicate that the majority of men spend their time far away from the farms either on employment, doing business or in search of opportunities for income generation to support their families. Whatever the case, the findings cannot tell whether women have some control over agroforestry trees existing on their farms. Among a number of communities in Kenya, decisions regarding agroforestry and crop production are generally held by men, while women participate less in deciding what trees or crops to plant, harvest and how much of the produce should be sold to the market (Catacutan and Naz, 2015). Sometimes, women are constrained by taboos and beliefs in agroforestry practices. For instance, women in Kakamega, western Kenya are not allowed to plant trees, in the belief that "if a woman plants a tree, she will become barren" (Ipara, 1992). However, joint decision-making on tree management results in higher densities of trees planted on farms compared to situations where decisions were made by the man alone (Meijer *et al.,* 2015). This is because of the supplementary gender interests that add up to increase desired quantity and diversity of tree species.

Majority (85.1%) of the respondents had secondary education and below, of which 10.5% did not go to school at all. According to Amaza and Tashikalma (2003) and Hawkins *et al.* (2009), the literacy level of farmers determines the rate of adoption of agroforestry practices

Table I. Diversity and Preference of Agroforestry Tree Species InKapsaret.

Species	Utilization				% Preference and availability
	Timber, fuel wood, charcoal,	*Furniture, posts,*	Ornamental Live fencing, shade	Edge tree	
Eucalyptus grandis	√	√	x	x	84
Grevillearobusta	√	√	√	√	62
Cuppressuslusitanica	√	√	√	x	80
Acacia mearnsii	√	√	√	√	39
Oleaafricana	√	√	√	√	38
Acacia tortilis	√	√	√	x	35
Prunusafricana	√	√	√	√	34
Eriobotyra japonica	x	x	√	x	33
Sesbansesban	*Fuel wood*	x	x	√	29
Juniperaprocera	√	√	x	x	25
Casuarinaequisetifolia	√	√	x	x	25
Pinuspatula	√	√	x	x	15
Croton megalocarpus	√	*x*	x	x	10
Acacia abyssinica,	√	*x*	x	x	10
Mangiferaindica	√	*x*	x	x	10
Warbugiaugandensis	√	*x*	x	x	6
Acacia melanoxilon	√	*x*	x	x	6

and technologies. Farmers who acquire some level of education are more likely to practice and benefit from agroforestry trees compared to the ones who have no formal education due to their enhanced ability to acquire technical knowledge like application of fertilizers, use of pesticides and improved planting materials (Jamala *et al.,* 2013; Amaza and Tashikalma, 2003; Hawkins *et al.,* 2009). Low level of education and personal characteristics hinders the utilization of agroforestry trees (Bankole *et al.,* 2012; Olujide and Oladele, 2011). The literacy level of farmers determines the rate of adoption of improved technology for increased productivity and directly affects their ability to adapt to change and to accept new ideas (Amaza and Tashikalma, 2003). Ntakyo *et al. (*2013) reports a strong relationship between education level of the household head and tree planting. This therefore gives a strong indication that the level of education plays a key role in tree planting and at the same time level of utilization.

Tree Cover on Farms

According to 27.2% of the respondents, tree cover on farms in Kapsaret has increased with increasing population over the years. An increasing population exerts increased pressure on land for food production (Mauambeta *et al.,* 2010). It has been observed that smallholder farmers are forced to undertake more intensive agriculture with continuous cropping, resulting in declining levels of soil fertility and crop yield (Sanchez and Swaminathan, 2005). Indeed poverty is an important limiting factor when it comes to agroforestry tree planting (Walker, 2004). Agroforestry fails to be taken up by the 'poorest of the poor', whose main priority is to get food on the table and who cannot afford too much risk-taking by investing time and labour in new technologies which have uncertain benefits in the long term (Jerneck and Olsson, 2014). In contrast, farmers who enjoy higher levels of food security are more likely to be 'opportunity seekers' and might be more inclined to venture into agroforestry (Jerneck and Olsson, 2014). Agroforestry practices however are likely to play a positive role in food security (Colfer *et al*., 2008; Vinceti *et al*., 2013; Arnold *et al*., 2011). Cultural perceptions, policy restrictions on tree felling on their own land, attitudes of farmers and their willingness to grow trees on their farms contributes to declining tree cover (Zubair and Garforth, 2006; Sood and Mitchell, 2004; Meijer *et al,.* 2015).

Preference and Utilization of Tree Species

Table I lists a total of 17 multipurpose tree species found on various farms in Kapsaret Sub County. The list is provided in order of preference, the most preferred tree

species being *Eucalyptus grandis* at 84%. *Acacia melanoxynon* and *Warbugia ugandensis* were the least preferred at 6% each. It is suggested that species preference was closely associated with the importance attached to the diversity of products and services they provided. *Eucalyptus grandis* was utilized for timber, fuel wood, mint, charcoal and shade (Table I). The high preference observed for *Grevillea robusta* (62%) was likely attributed to its fast growth, ability to improve degraded soils, and low canopy structure, hence the suitability for planting on farm boundaries. In Mymensingh, Bangladesh farmers did not want to plant trees with wide spread canopy in their crop fields, but preferred Eucalyptus for boarders (Ibrahim *et al*., 2011; Belali, 2011), despite their high water and nutrients consumption rates, therefore altering the hydrological cycle and depleting nutrients in the soil (Munslow *et al*., 1988).

Availability of Agroforestry Trees

Eighty-two percent (82%) of the respondents in Kapsaret strongly agreed that a diversity of agroforestry tree species existed on their farms. Following field observation made in this study, 17 different tree species were identified. These trees had potential to supply a wide range of products and services desired by the local people. However, the same study observes that existing government policies, cultural restrictions, lack of capacity to implement regulations on utilization of trees (Arnold and Dewees, 1998), insecurity and/or general laxity by government tend to hinder use of these trees. Availability may, therefore, not necessarily mean that the tree can be harvested for use (Simons and Leakey, 2004) due to these factors. Consequently, there is need to lobby relevant Government agencies to re-examine existing government policy, and to sensitise local communities on the pros and cons of culture. On the other hand, eighty-seven percent (87%) of the respondents strongly believed that local institutions such as Kenya Forest Service and Kenya Wildlife Service lacked the capacity to articulate for the removal of Government policies that limited utilization of agroforestry trees. Existence of trees on the farm does not translate to its availability for use.

Utilization of Agroforestry Trees

Utilization of agroforestry trees is the extent to which farmers use agroforestry tree resources (Leakey, 2004). It is a farmer-driven and market-led process that takes a participatory approach to involve local communities (Simons, 1996). In this study, the respondents strongly agreed that agroforestry trees generated substitute income from purchased products (83%), produce timber and fuel wood (77%), improve soil fertility (47%), increase food security (28%) and produce fodder (10%). The contribution of trees to soil improvement is one of the major assets of agroforestry. As a soil improving agent, agroforestry trees have been shown to positively alter the soil-crop environment by improving soil aggregation, enhancing water infiltration and water holding capacity. These reduce water runoff and soil erosion and thus contribute to reduction of the effects of droughts in soils under trees (Phiri *et al.,* 2003).

Figures III_a to III_d, show some of the socio-economic benefits attributable to agroforestry in Kapsaret. Firstly, *E. grandis*trees (III_a) produce poles, posts and sawn timber (III_b) for construction and furniture (III_c). They also act as windbreaks as well as co-exist in a sustainable manner with food crops and animals (III_d). In Europe, growing trees and crops in agroforestry systems generates a higher value of ecosystem services than growing them separately (Glover *et al.,* 2007).

Although the actual and potential benefits of agroforestry have been well documented, agroforestry is neither the only nor the total solution to food insecurity and environmental degradation (FAO, 2013). Utilization and species diversity of agroforestry trees in Kapsaret was found to be hampered by Government bans on species like *Juniperus procera*, which reduced the rate at which farmers plant this particular species. They would rather plant species like *Eucalyptus grandis, Cupressus lusitanica* or *Grevillea robusta* which they can harvest and utilize.

Socioe*conomic* Perspectives That Influence Availability and Utilization of Trees

Table II lists the main socio economic perspectives that strongly influence availability and utilization of agroforestry trees in Kapsaret

Gender

Over 50% of respondents in the study strongly agreed that labour, level of education, household security, gender, land and tree tenure and availability of

Figures III$_a$ to III$_d$, Show some of the socio-economic benefits attributable to agroforestry In Kapsaret.

information influences the management, utilization, species preference and availability of trees on farms. Seventy-eight percent (78 %) of the respondents agreed that men and women play different roles in the community hence in different ways hinder the availability and utilization of agroforestry trees. Men, for instance, may wish to keep trees on their farms for timber and poles to support construction, while women may do the same for fuelwood. This becomes a challenge when it comes to management and harvesting due to conflicting interests between the genders.

Level of Education

According to 73% of respondents, education improves knowledge, management skills and extension services in agroforestry. This was supported by Amaza and Tashikalma (2003) who agreed that level of education lead to change in knowledge, management skills and extension services of agroforestry trees. However, Bankole *et al*. (2012) was of the opinion that level of education did not have effect on planting, management and utilization of agroforestry trees.

Land and Tree Tenure

To date, no clear consensus has emerged across varying sub-Saharan Africa contexts on whether and how stronger land tenure security may, in general, incentivize farmer decision-making and pursuit of different land investment strategies on their farms (Place, 1995; Place *et al.,* 2002; Place *et al.,* 2004). This is because there are few empirical studies that have demonstrated a definitive link between improved tenure security and changing agroforestry practices (Arnold *et al.,* 2011). However, land tenure is an important factor in planting, managing and utilizing agroforestry trees. In this study, 99% of respondents strongly believed that land and tree tenure had a direct influence on the level at which farmers in Kapsaret utilized the trees on their farms. Security of

Table II. Perspectives That Strongly Influence Availability and Utilization of Agroforestry Trees InKapsaret.

Socio-Economic Perspectives	Influencing Availability Of Trees (%)	Influencing Utilization Of Trees (%)
Gender	78	79
Level of education	73	58
Household security	79	74
Land and tree tenure	77	99
Availability of labour	69	58
Farm size	33	96
Aceess to market and cash income	41	63
Information and training	78	81

tenure over the cultivated land stimulates the farmers' commitment to protect and develop the area owned. Fortmann (1985) presents a case where the landowners have the right to the fruits which their tenants could harvest for personal use, but never for sale. Without the landlord's permission they could not fell certain trees. In such a system, sustainable management of agroforestry trees may be difficult. Land tenure influences farm income and agroforestry systems can produce cash income through marketing of tree products (Speranza et al., 2008). Pattanayak *et al*. (2003) identified tenure security and extension support as two of the most important determinants of increased agroforestry practice. Land ownership and transfer through inheritance are customarily almost exclusively on an individual male tenure, which hardly gave provision to women's access and permanent ownership rights. In this respect, men influenced decisions relating to land allocation for tree planting and utilization (Edinam *et al.,* 2013) and is linked to the seventy-nine percent (79%) of respondents in Kapsaret who believed that household security affected domestication of agroforestry trees.

Farm Size

According to the data, 96% of the farmers in Kapsaret strongly believed that farm size had direct implications on utilization of agroforestry tree species, while 33% believed that farm size influenced farm income. The sub-county has an average of 1.5 acres as the land holding by the farmers (Busienei,1991). Earlier studies (Busienei, 1991) found direct competing uses of land, labour and capital. When farm sizes are limiting, farmers utilize their farms for subsistence farming and non-perennial cash crops such as wheat and maize, sidelining tree planting. When farm sizes are large, farmers tend to adopt agroforestry technologies more easily. Likewise, Oino and Mugure (2013) found a strong relationship between size of land and the number of trees planted on the farm.

Information and Training

According to 81%of respondents, information and training highly influenced utilization and availability of agroforestry trees in Kapsaret. Relative to other agricultural activities, farmers need more information and training for agroforestry (Busienei, 1991). Extension strategies, including field schools, exchange visits and farmer training, are effective ways of disseminating agroforestry information. Unfortunately, Agricultural extension officers concentrated on crops and animal production, while on the other hand, Forest Extension officers embarked on tree planting activities only. Many agricultural extension workers are not familiar with trees and shrub species that could fit in an agroforestry system. These agricultural trained extension agents have little knowledge about agroforestry trees with respect to their vernacular names, ecology, propagation, management and uses. On the other hand, forestry extension workers tend to view tree species from a purely "forestry" point of view, and neglect the needs and constraints identified by farmers. Most of the respondents in Kapsaret cited faulty extension services, with inadequate follow up visits or insufficient time for training and advice. Hence, the extent of general smallholder farmer extension services is declining (Kiptot and Franzel, 2014). Ipara (1992) observed that poor extension services and understaffing were the main bottlenecks to agroforestry technology adoption by women in Vihiga division. Likewise, farmers in Kapsaret believe that there is a direct influence of extension services

on utilization of agroforestry trees (Oino and Mugure, 2013) and there is need for the government and other development agencies to intervene by providing information and training to farmers who are ignorant of the benefits of engaging in agroforestry farming.

Access to Market and Cash Income

Sixty-three percent (63%) of farmers in Kapsaret strongly believed that access to reliable market for agroforestry tree products directly affected its utilization. For many agroforestry tree products, markets are poorly structured and coordinated (Roshetko *et al*., 2002). Poor unstructured markets result in low and unstable returns to farmers and high prices for buyers of tree products, which in turn limit their consumption. Problems often cited by producers include the absence of a collective bargaining system, poor transport infrastructure, and the involvement of multiple intermediaries in the supply chain, all of which act to reduce farm prices hence affect the level of utilization of agroforestry tree species. Market assessment and strategic marketing of agroforestry products are essential for agroforestry enterprise success. Kumar's (2006) review study of Asian agroforestry concludes that, in order for agroforestry to be a viable livelihood option, there needs to be institutionalized channels of support to market access. Looking for a market only in times of surplus can be disappointing (FAO, 2005).

Roshetko *et al*. (2002) hypothesises that commercial opportunities exist for farm communities to transform their traditional agroforestry systems towards market orientation. Traditional management approaches produce small quantities of many products primarily for household consumption with limited market sales. Furthermore, replicable and efficient extension approaches should be designed to reach motivated and innovative farmers who are committed to improving their incomes by increasing the production and market access for their agroforestry products (Roshetko *et al*., 2002). Forty one percent (41%) of respondents in Kapsaret agreed that agroforestry systems can produce cash income through marketing of tree products.

Availability of Labour

Labour did not emerge as a limiting factor among farmers in Kapsaret. According to this study, there were more adult members in each household and this meant that more quality labour would be available to carry out farming activities. Therefore, the practice of agroforestry would not pose any labour-related problems. The observation was in agreement with the findings of Villano and Fleming (2004) and Ajayi *et al*. (2003) who states that age has been extensively considered as a socio-economic factor influencing the practice of agroforestry.To explore the link between availability, utilization and socio-economic variables, Pearson's co-efficient of correlation (Cohen and Holiday, 1982) indicates that availability of agroforestry trees is highly associated with socio-economic perspectives (87.7%) than with their utilization (78.6%).

CONCLUSIONS

Seventeen major multipurpose tree species were identified on the farms in Kapsaret. *Eucalyptus grandis* was the ddominant and most preferred species due to its diverse products and services. Trees on farm improve cover, co-exist with food crops and are utilized for fodder, soil fertility improvement, timber and fuel wood. However, their management, preference, availability and utilization is strongly restricted by the level of education, household security, gender, land and tree tenure and availability of information but least by market access and farm size. There is a strong association between socio-economic perspectives and availability of trees on farms than with their utilization. In this regard there is need to promote agroforestry technologies and practices and to build capacity of land users in Kapsaret.

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