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On-farm Conservation and Use Values of Indigenous Tree Species in Uganda

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Abstract

Conservation of indigenous tree species is crucial for restoration of ecosystems and provision of livelihood support functions among rural communities. However, most tree planting initiatives have promoted exotic species, ignoring native species which populations have for long depended on. This study assessed the indigenous tree species conservation and Use Values in the Kyoga plains and the highland ranges Agro Ecological Zones of Uganda. A semi-structured questionnaire was used to capture primary data from a total of 422 household heads. Data were coded and entered in SPSS statistical package (Version 16). Descriptive statistics were generated to establish the distribution of indigenous trees on farms and tree management options employed by farmers. Chi-square test at 5% probability level was used to assess whether there was any difference in indigenous tree establishment, propagation and management options in the four study districts. The Use Value index technique was used to rank and prioritize 20 indigenous tree species. Most of the local communities in Eastern highland ranges prefer planting and retaining indigenous tree species in crop fields, while deliberate tree planting in the vicinity of family compounds (homestead) was predominant in the Kyoga plains. Indigenous tree species mode of establishment, propagation and management options significantly differed across the four study sites ($P<0.05$). The overall tree species Use Value Indices generally correspond to the number of uses of a particular tree species and vary between 2.4 and 0.2. Our study findings show rather a narrow range between the highest and least use value, implying that communities generally valued a particular tree species for at least more than one preferred use. Local communities prefer protecting naturally growing indigenous tree seedlings than planting. They facilitate tree regeneration when the benefits of their investment are guaranteed and the economic value such trees can provide to the household. Therefore, while evaluating indigenous tree species for relative importance and use, the end objectives of such evaluation must be critically examined in light of the interest of different tree resource user groups.

Keywords: Conservation, indigenous trees, use-value, agro ecological zones.

Introduction

Conservation of indigenous tree species is crucial for restoration of ecosystems and provision of livelihood support functions[1]. Conservation of indigenous tree species is not just a recent practice. Rural communities have, for long, relied on indigenous trees for food, medicine and income[2-4]. These species also contribute to a cleaner environment as they sequester more carbon compared to exotics[5]. Often, collection, processing and marketing of indigenous tree products represent a significant portion of rural household income particularly where farming is marginal[6].

With more intensification of agroforestry, exotic tree species have begun to dominate agricultural landscapes. Most tree planting initiatives are promoting exotic species ignoring native species on which populations have for long depended[7], leading to neglect of indigenous species which are more adapted to local environments. Also, many indigenous tree species are becoming scarce due to unsustainable land management practices and destructive harvesting methods. For example, harvesting products such as medicine from indigenous trees is often destructive and leads to wood deterioration due to insect damage and fungal infection[8]. Developing sustainable harvesting and processing methods will go a long way in ensuring continued supply of valued products from indigenous tree species.

Deforestation trends suggest that rising demands for tree products will be met by increased levels of tree planting[9]. Sanchez[10] indicated that domestication of indigenous tree species with high value products enhances profitability. The contribution of indigenous tree species to livelihoods improvement will be boosted by more certainty about potential indigenous trees and their characteristics[11]. This study examined the on-farm distribution, establishment, management, uses and use values of indigenous tree species by local communities in the Kyoga plains and the Eastern highland ranges agro ecological zones (AEZs) of Uganda. Study findings are intended to inform strategies for enhancing the conservation and wise use of these species to ensure their sustained contribution to livelihoods and resilience of ecosystems.

Material and Methods

Study area: The study was conducted in the Eastern highland ranges and Kyoga plains AEZs of Uganda. The eastern highland ranges AEZ comprises of 7 districts including Manafwa, Sironko, Mbale, Bulambuli, Bududa, Kapchorwa and Bukwo. The farming system is characterized by growing of bananas which is the staple food and Arabica and Robusta coffee as the main cash crops. The mean annual rainfall ranges from 1500 mm on the eastern and northern slopes, to 2000 mm in the southern and western slopes. The mean maximum and minimum temperatures are 23°C and 15°C respectively. Because of the steep terrain, the AEZ is experiences landslides and soil erosion. Four broad vegetation communities are recognized, namely; mixed montane forest up to an elevation of 2500 masl, bamboo and low canopy montane forest from 2400 to 3000 masl, and moorland above 3500 masl[12].

The Kyoga plains AEZ is also found in eastern Uganda particularly in Kayunga, Kamuli, Iganga, Bugiri, Tororo, Busia, Pallisa, Kumi, Soroti, Kaberamaido, Lira and Apac districts of Uganda. The zone is characterized by lowland rain fed conditions with average rainfall ranging from 1215 mm - 1328 mm. Evaporation in this part of the zone exceeds rainfall by a factor of approximately 8 during the dry months of December to February. Temperatures and altitude range from 15 – 32.5 °C and 914 – 1,800 masl respectively. The main agricultural crops include rice, sweet potato, maize, cassava, and banana[13].

Sample size and sampling procedure: Two study districts were randomly selected from each AEZ: Sironko and Manafwa from the eastern highlands, Tororo and Lira from Kyoga plains. This was followed by a simple random sampling of individual households. Cross-sectional data were collected from a total of 422 households from Sironko (120), Manafwa (117), Tororo (60) and Lira (125) districts. Key informant interviews were held with processors of specific products from indigenous tree species to gain in-depth information regarding different aspects of indigenous tree species utilization and contribution to livelihoods.

Data collection: Both primary and secondary data were collected during the study. A semi-structured questionnaire was used to capture primary data from selected household heads using direct interviews conducted at their respective farms. Primary data included identification of priority indigenous trees, their availability and distribution in the AEZ, propagation and management options, products accruing from indigenous tree species, existing harvesting methods and their contribution to household livelihood. Secondary data included reviewing of previous research findings on utilization of indigenous tree species and their contribution to local community livelihoods.

Data analysis: Primary data were coded and entered in SPSS statistical package (Version 16). Descriptive statistics in the form of percentages were generated to identify priority indigenous tree species, their establishment and tree management options employed by farmers. The on-farm distribution of indigenous tree species was presented in form of a bar graph. Chi-square test at 5% probability level was used to assess whether there were any significant differences in indigenous tree establishment, propagation and management options among the four study districts of Manafwa, Tororo, Sironko and Lira. Farmers' responses on products and services of existing indigenous tree species were summarized in a table.

The Use-Value Index technique as applied by Phillips and Gentry[14] was used to rank and prioritize 20 indigenous tree species reported by the respondents. This technique is based on the number of uses and the number of people that cite a given tree species [15, 16], indicating the species that are considered most important by a given population. The use values were determined using the formula by [17]:

$$UV = \Sigma U_i/n \qquad (1)$$

Where: U_i is the number of uses mentioned by each respondent for a given species, n is the total number of respondents and Σ stands for summation.

The species were then ranked (1-20) basing on the overall use value, where a rank of 1 and 20 was considered the most important and least important respectively.

Results and Discussion

On-farm distribution of indigenous trees: Trees are an essential component of the indigenous agricultural systems[18]. When local communities clear land for farming, they leave a wide selection of indigenous tree species on farmlands[19], most commonly retained along boundaries and within the crop land[20]. Although most of the local communities in the eastern highland ranges prefer planting and retaining indigenous tree species in crop fields, deliberate tree planting in the vicinity of family compounds (homestead) was predominant in the Kyoga plains (figure-1). Homesteads were preferred because browsing and fire can be controlled and the use of manure and refuse can be applied more easily than in a distant field. Women in particular indicated that they prefer planting trees near the house so they do not have to leave their homes for a long time in search of medicine and animal fodder. In addition, planting near home reduces the risk of fruits being surreptitiously collected from their trees by others. According to Fernandes and Nair[21], planting and retaining of trees around homesteads is a more deliberate by farmers. Such trees and shrubs are usually multipurpose[22,23]. Planting along boundaries is also done to mark the borders and to ward off stray animals. Most of the tree species are maintained to meet the immediate needs of the household such as food, medicines, income, handcraft materials and ecological needs.

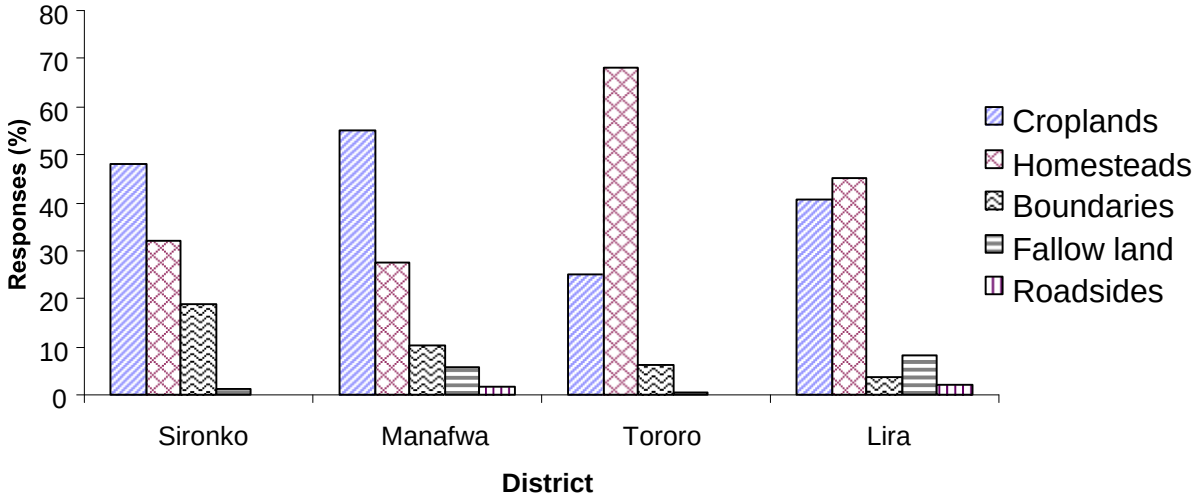


Figure-1
Distribution of indigenous trees on-farm

Several studies have stressed the role of trees in increasing the overall farm productivity[24-26] and improving livelihoods rural farming communities [27]. According to Appiah and Pappinen [28], integration of trees into farming systems is important for on-farm biodiversity conservation and diversification of tree products. On-farm conservation is the sustainable management of genetic diversity of locally developed traditional tree varieties by farmers within traditional agricultural systems [29, 30]. It is an approach to in-situ conservation of genetic resources, focusing on conserving cultivated plant species in farmers' fields from which tangible benefits can be accrued[31]. In-situ conservation means preserving varieties cultivated by farmers using their own selection methods and criteria[32].

Local communities have seldom been consulted about which tree species they consider valuable and why, yet technical interventions should be based on tree species that are locally acceptable and useful[33, 34]. Conservation is greatly influenced by both the perceived and actual attitudes people have towards planting trees on their farmland due to the benefits that they get from trees. According to Maxted *et al* [35], building an on-farm conservation initiative requires efforts from institutional frame works for their implementation. Such institutions include farmers, farmers' organizations, Community-Based Organizations, Civil Society Organizations, National Research Institutes, Government ministries and International Institutes. Initiating on-farm conservation therefore involves strengthening of the national frame works through training and equity[36] so as to increase national capacity and participatory approaches to research and plant breeding.

Indigenous tree establishment, propagation methods and management options: Indigenous tree species are an integral part of land resources that need careful management for sustainable utilization[37]. In this study, most of the respondents acknowledged that the indigenous tree species existing on their farms were retained, with most of the retention being practiced in the Eastern highland ranges AEZ (table-1). This implies that local communities usually prefer protecting naturally growing indigenous tree seedlings than planting them from seed and seedlings. According to Obua[38], farmers can facilitate regeneration of local indigenous trees only when the benefits of their investment are guaranteed and as a response to the economic value such trees can provide to the household.

In this study, indigenous tree species establishment, propagation and management options were significantly different across the four study districts ($P<0.05$) (table-1). This implies that farmers apply varying methods of establishing, propagating and managing indigenous tree species. For example, while majority (80.1%) of the respondents in Sironko district retained trees, in Tororo, about 55% planted trees on their farms. Apart from pruning, there is hardly any tree management option applied to indigenous tree species by farmers across the two AEZs. Inadequate management of trees on-farm can slowdown restoration of lost productive capacity in farm land and promotion of local enterprises, reduction of poverty and food security[39].

Indigenous tree species Uses and Use Values: Uses of indigenous tree species vary among communities and regions[37]. In Uganda, farming households have for long relied on indigenous trees for food, medicine and household income[11, 40]. In this study, local communities generally value indigenous tree species for firewood, timber, food/ fruit, handcraft materials, fodder, charcoal and sources of herbal medicine (table- 2).

The assessment of Use Value entirely relies on an ordinal measure of the relative utility of tree species to the local communities and the technique reflects the importance of a species to the respondent objectively[41]. In this study, the overall tree species use values generally correspond to the number of uses of a particular

tree species and vary between 2.4 and 0.2 (table-2). Our study findings show rather a smaller range of plant use value compared to that of Wilfred *et al* [42] on the indigenous plant use values in Uluguru Mountains in Tanzania which revealed a range of 2.81 to 0.08. This implies that communities in the Eastern highland ranges and Kyoga plains AEZs of Uganda generally valued a particular tree species for at least more than one preferred use.

Since varying morphological characteristics of the woody plants make some of them more suitable to provide certain values to the local communities[43, 44] some woody plant species are considered more important than others. For example, the local people value species like *Mangifera indica,* with the highest overall use value, for fruit, fodder, firewood, medicine and shade (table-2). However, tree species suited for more than one use have a high competitive use. Hence the use value technique tends to place more emphasis on species that have many uses even when the uses are only known to a few people[17].

This study also identified a set of tree species with low use value especially in Tororo and Manafwa districts. These low values could be associated with processes of losing traditional uses of indigenous trees[45], generational changes of preferences and probably the diminishing of traditional knowledge[46]. Although we did not analyze the past use of plants, we can hypothesize that the low use value recorded in this study for species such as *Piliostigma thonningii, Erythrina abyssinica, Terminalia macroptera* and *Combretum molle* might be due to a decrease in their use and knowledge over time. For example, local communities were unable to consider categories such as ritual or sacred uses, which used to be of great value to past generations. This makes tree species use value dynamic and changing through time in a human group or between sectors of a human group at a given time. Other cases are the substitution of plant products by commercial non-plant products[15]. For instance, wooden stools and chairs have now been replaced by plastic chairs. Low use value scores of some indigenous tree species could also be associated in part with their scarcity. According to Benz *et al* [47], the use of a plant resource is a function of its abundance, with more abundant species being more extensively used. This implies that the low use value of some plant species could be related to their scarcity or the decrease of their populations.

Conclusion

Sustainable utilization of indigenous tree species will benefit from better understanding of their role in people's livelihoods and conservation of both high and low use-value tree species of economic and ecological importance. It is likely that the most important species will suffer the greatest harvesting pressure from local communities. Therefore, while evaluating indigenous tree species for relative importance and use, the end objectives of such evaluation must be critically examined in the light of the interest of the different tree resource user groups. There is also need for development of appropriate propagation and management techniques for most indigenous tree species to ease their multiplication.

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Table-1

On-farm tree establishment, propagation and management options

District	Establishment method (%)		Propagation method (%)				Tree species management (%)				
	Planted	**Retained**	**Seed**	**Seedlings**	**Stem cuttings**	**Wildings**	**None**	**Prune**	**Coppice**	**Fence**	**Weed**
Sironko	19.8	80.1	10.9	56.6	17.1	15.4	73.3	13.5	12.7	0.5	0
Manafwa	29.9	70.1	10.4	57.2	12.9	19.4	32.7	48.2	1.8	0	17.3
Tororo	56.9	43.1	14.4	20.3	9.7	55.5	52.7	42.1	4.7	0.5	0
Lira	55.4	44.6	17.1	27.2	2.4	53.3	37.9	51.2	9.4	1.2	0
Total (%)	**42.1**	**57.9**	**13.9**	**39.9**	**8.8**	**37.3**	**45.8**	**41.6**	**7.9**	**0.7**	**4.0**
χ_2	438.17		817.76				1080.81				
P –Value	0.002*		0.001*				0.001*				

**Significant at 1% significance level*

Table-2
Use Value, harvesting methods, products and services from indigenous tree species

Tree species	Use- Value Index (UVI)				Overall UVI	Species Rank	Products and Services	Harvesting methods
	Sironko	Manafwa	Tororo	Lira				
**Mangifera indica*	2.7	1.4	1.7	3.5	2.4	1	Fr, Fw, Sh, Med, Fod	Climb, hook, hand pick, prune
Ficus natalensis	2.9	1.3	0.9	1.7	1.7	2	Fod, Sh, Bc, Med	Debark, prune, dig roots
**Persea americana*	0.6	1.0	0.1	1.6	0.9	4	Fr, Fw	Climb, hook, prune
Psidium guajava	1.4	0.3	0.5	0.4	0.7	9	Fr, Fw	Pick from tree and ground, fell
Markhamia lutea	1.6	0.6	1.3	1.7	1.3	3	Tim, Fw, Po, Sfe	Fell
Albizia coriaria	1.2	0.4	1.0	1.3	0.9	4	Tim, Sh, Char	Fell
**Artocarpus heterophylus*	0.3	1.9	0.2	1.9	0.9	4	Fr, Fw, Med	Climb, hook, prune, pick leaves
Cordia africana	0.4	2.0	0.4	0.7	0.9	4	Tim, Fw, Char	Fell whole tree
Albizia zygia	0.1	2.5	0.1	0.1	0.7	9	Tim, Fw, Char	Fell whole tree
Vernonia amygdalina	0.5	0.3	0.5	1.2	0.7	9	Med, Fod, Fw	Pluck leaves, fell, prune
Vitellaria paradoxa	0.9	0.2	0.2	2.1	0.8	8	Fr, Med, Char, Oil	Pick from ground
**Citrus sinensis*	0.0	0.0	0.1	1.4	0.4	14	Fr, Med	Hook, climb, pick off leaves
Annona senegalensis	0.1	0.0	0.5	1.0	0.4	14	Med, Fw	Pick, dig roots
Maesopsis eminii	0.1	0.5	0.3	0.8	0.6	12	Tim, Sh, Char	Fell
Milicia excelsa	0.8	0.4	0.2	0.7	0.6	12	Tim, Cr, Char	Fell, prune
Tamarindus indica	0.0	0.1	0.9	0.5	0.4	14	Fw, Med, Fr, Char	Hook, fell
Piliostigma thonningii	0.4	0.2	0.0	0.1	0.2	20	Med, Fw	Fell, dig roots
Erythrina abyssinica	0.0	0.0	0.3	0.8	0.3	17	Po, Med, Cr	Debark, fell, prune
Terminalia macroptera	0.1	0.0	0.0	0.8	0.3	17	Char, Fw, Po	Fell
Combretum molle	0.1	0.0	0.2	1.0	0.3	17	Char, Fw, Med, Po	Fell

**These species have been naturalized over time and most local communities now regard them as indigenous species. UVI = Use Value Index, Cr =Craft, Fw = Firewood, Char = Charcoal, Po = Poles, Fod = Fodder, Tim = Timber, Med = Medicine, Fr = Fruit, Sh = Shade, Bc= Bark cloth, Sfe= Soil fertility enrichment.*

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