Locally Preferred Woody Species and Their Management in Kiruhura and Arua Districts, Uganda

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Research

Abstract

Trees and shrubs are disappearing fast in anthropogenic landscapes of Uganda. In order to promote their conservation on-farm, there is need to involve farmers. Farmers' involvement in tree/shrub management requires a clear understanding of the households' needs that trees can satisfy, the priority species to satisfy these needs, as well as tree management practices and challenges that hinder tree planting. This study was carried out to satisfy these information needs and to also determine species that are locally threatened. The study was conducted in selected villages of Arua and Kiruhura districts between June and October 2012 using an ethnobotanical approach. Our results indicate that farmers value tree products to satisfy household welfare needs of accessing food (edible fruits), generating income, and accessing construction wood. The species are multi-purpose, and the most preferred are *Eucalyptus* spp., *Mangifera indica* L., *Persea americana* Mill., *Carica papaya* L., *Citrus limon* (L.) Osbeck, *Artocarpus heterophyllus* Lam., *Citrus sinensis* (L.) Osbeck, *Annona senegalensis* Pers., *Pinus* spp., and *Tectona grandis* L.f. Most farmers maintain trees on their land in courtyards, backyard gardens, or crop fields and ranches. Tree species are threatened by destructive harvesting and clearing land for agriculture. The key challenges to intensification of tree cultivation are livestock damage, land shortage, drought, and lack of financial resources. Farmers suggested that in order to strengthen tree planting, they should be provided with inputs including seedlings, chemicals, and tools. In conclusion farmers prefer exotic tree species to satisfy household needs. Intensification of tree management will need to address a number of challenges identified in this study.

Introduction

Many woody species depended on by people in the developing world are threatened by factors such as overexploitation or habitat conversion and are thus disappearing. Rural and marginalized people, especially women (Upadhyay 2005), are highly dependent on woody plants for their subsistence and income generation (Marshall & Newton 2003). For example, in Ethiopia pastoralists depend on *Dobera glabra* (Forssk.) Juss. ex Poir. for browse during the dry season (Tsegaye *et al*. 2009), while households in Cameroon earn about 2629 USD per annum from *Gnetum africanum* Welw. sales (Kiptot & Franzel 2011). Woody plants also provide environmental services that benefit communities such as flood control (Chan *et al*. 2006) or climate change mitigation and building resilience in vulnerable regions (Pacala & Socolow 2004). The loss of trees/shrubs can therefore cause extensive suffering

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among people who rely on them to satisfy their needs and welfare (Shackleton *et al*. 2001), and loss of tree cover needs to be slowed down by actions that include growing and maintaining trees on-farm.

Effective tree growing requires full participation of farmers. This is important because farmers own important resources for tree growing such as land. Furthermore, farmers make decisions regarding which species to maintain on their land based on assessments of how much they will benefit from growing a particular species and how such a species fits in the household's labor and input requirements (Dalle & Potvin 2004, Scherr 1995, Simons & Leakey 2004, Warner 1994). To enhance and encourage wider tree planting on-farm by farmers, therefore, the species that they value and which they want to grow and are ready to manage should be identified for wide-scale planting with scientific inputs and management practices (Dalle & Potvin 2004, Kahurananga *et al*. 1993). These are usually trees that satisfy household needs but which also have market potential and from which farmers can earn incomes to provide alternative sources of livelihood (Akinnifesi *et al*. 2008, Baldascini 2002, Gyau *et al*. 2012, Scherr 1995). Additionally, farmers prefer fast-growing tree species (Akinnifesi *et al*. 2008) and trees with multiple benefits such as *Eucalyptus* spp. (Dessie and Erkossa 2011). According to Arnold and Dewees (1998), farmers' management and planting of trees increases under circumstances of declining supplies of tree products from forests to (1) meet growing demands for tree products, (2) to maintain agricultural productivity, and/or (3) to reduce and manage risk. Decisions to plant trees are influenced by factors such as agroecological characteristics of the area; land use practices; availability of labor, land, and tree tenure and control; and market growth for tree products such as poles, firewood, seedlings, and fruits (Arnold & Dewees 1995).

Additional important information is an understanding of tree management practices that include which species are managed by famers on their land. Such assessments indicate which species are preferred by farmers and are actually managed by them and also the extent of tree management. The expectation in this context is to find high value species that are deliberately planted or retained on-farm and that have high abundances in intensively managed landscapes. Conversely, low value species are expected to have low abundances and low distribution in anthropogenic landscapes. This project was conducted to determine (1) household needs that can be satisfied by trees, (2) the most preferred tree species and why they are preferred, (3) existing tree management practices, (4) existing challenges to tree planting, and (5) species that are locally threatened. Fieldwork for this study was conducted between June and October 2012 using an ethnobotanical approach.

Study Area

The study was conducted in selected villages of Manibe and Nyakashashara sub-counties, in Arua and Kiruhura districts, respectively. Kiruhura and Arua districts are located in the Pastoral Rangeland zone in western Uganda and the Savannah Grasslands zone of northwestern Uganda, respectively. Manibe is located at 3.1°N and 30.9°E and Nyakashashara at 0.4°S and 31.1°E (Figure 1).

The study area description for Kiruhura is based on a review by Bloesch (2001). The topography of Kiruhura is comprised of smooth, rounded hilltops with gentle to moderate slopes, valley bottoms, and wetlands. Rainfall is bimodal extending from March–May and (October)–November–December. The mean annual rainfall is 887 mm. Rainfall is rather unpredictable but with low inter-annual variability. The mean annual temperature is 22.9°C. Existing soil types are ferrisol, histosol, vertisol, and leptosol. The vegetation is classified as the Lake Victoria Regional Mosaic and has the following sub-types: encroached savanna with *Acacia hockii* De Wild. and thicket clumps, tree savanna dominated by *Pappea capensis* Eckl. & Zeyh., and grass savanna and tree savanna with *Acacia gerrardii* Benth. The main land uses are a National Park, cattle ranching, and crop agriculture.

The Arua District according to Arua District Local Government (2004) has a topography of rolling plains. The landscape around Manibe is classified as the Western Highland occupying an altitudinal range of 1200–1800 masl. The rainfall of Arua is bi-modal, and the wettest months are normally August and September which receive 120 mm/month. The average total rainfall is 1250 mm. The soils are predominantly ferralitic and sandy loams. The original vegetation of Manibe was described by Langdale-Brown *et al*. (1964) as dry *Combretum* savanna comprised of *Combretum-Acacia-Hyparrhenia*/*Combretum-Hyparrhenia* plant communities and *Vitellaria* savannas with *Vittelaria-Hyparrhenia* plant communities.

The people of Arua District are ethnically Lugbara by tribe while those of Kiruhura are Banyankore. Kiruhura and Arua districts have populations exceeding 271,000 and 565,000, respectively (UBOS 2002), and population growth rates of 3% per annum. The average farm size for Arua is 2 acres (range 0.25–7 acres) and 36 acres for Kihura (range 1–250 acres) (data generated in this study). Almost all households (99%) use firewood and charcoal for cooking (UBOS 2002). The economy of Arua is built on agriculture which employs over 80% of the total population. Family members constitute the single most important source of labor. Both food and cash crops are grown. The major food crops include cassava, beans, groundnuts, simsim, millet, and maize. Tobacco is the major cash crop and is the main source of livelihood for the majority of the

population in the district. The chief means of livelihood in Kiruhura is livestock rearing. Some farmers subsist by growing cooking bananas.

Methods

Data for this study were collected using an ethnobotanical approach. Respondents were selected using a multi-stage sampling procedure based on the local administrative units. The local administrative units in Uganda, from the district level as the highest, are county, sub-county, parish, and village. One county was randomly selected from within the district. In turn, three sub-counties were randomly selected from the county, three parishes from a sub-county, and three villages from each parish. In every village, a list of all inhabitants was generated to use as a sampling frame with the help of the local area politician (Local Council I, Chairperson). Household samples were randomly distributed between the different genders. In this way 90 households were randomly selected in Arua and 91 in Kiruhura. The sample, overall, included 95 women and 86 men. These techniques are described by NRI (1996), Martin (1995), Sarantakos (2005), and Sheil *et al*. (2002). A token of appreciation was paid to every respondent after the interview to compensate for their time (see Van Den Brakel *et al*. 2006).

For every selected household, we interviewed the household head using structured open- and closed-ended ques-

Figure 1. Location of study districts in selected villages (**M**: Manibe and **N**: Nyakashashara) of Arua and Kiruhura, Uganda, where the woody species were documented.

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Table 1. Example of computation of use values for *Ziziphus abyssinica* A. Rich. in selected villages of Arua and Kiruhura, Uganda.

Value	Firewood	Fencing	Charcoal	Crafts	Total
Number of times value is mentioned	5	3	1	2	
Use value	0.028	0.017	0.006	0.011	0.061

tionnaires in face-to-face interviews. To determine the most preferred woody species, every respondent was asked to list at least 10 species that he/she considered useful. Additional data were collected on species sold, existing tree management practices, constraints people face when managing trees, opportunities that exist for tree management, and status of tree ownership at the homestead level. Lastly, respondents were requested to list species that are becoming locally scarce, those that are becoming abundant, and the factors that have contributed to these changes. Demographic data were collected for all respondents and direct observations made on issues relevant to the study objectives, such as destructive harvesting of trees and vegetation types. We also conducted group interviews in each district to determine household needs for trees. Plant voucher specimens were collected and identified by staff of Makerere University Herbarium (MHU). The specimens were indexed as AN.

All survey data were entered in a spreadsheet, checked for errors, and edited before analysis. Frequencies were generated by the pivot tool in Microsoft Excel 2007. To determine the priority species we computed a use value by summing the number of times a given value was mentioned for a given species and dividing the summed value by the number of all respondents,

$$V_s = \sum \frac{f_i}{n}$$

whereby V_s is the use value for a species s; f_i is the number of times a given value is mentioned for species s by respondents; and n is the total number of respondents. For example *Ziziphus abyssinica* A.Rich. was mentioned 5, 3, 1, and 2 times for use as a source of wood for firewood, fencing poles, charcoal, and craft, respectively. The respective use values for the above uses are 0.028, 0.017, 0.006, and 0.011, with a total V_s of 0.061. From this analysis species importance can be compared by individual use values. Furthermore, for every species the most important value can also be determined. For *Z. abyssinica* the most important value is that it is a source of firewood. A summary of this computation is shown in Table 1.

The use value was modified from that proposed by Philips & Gentry (1993) who proposed asking the same person several times about the same species. We instead considered the number of times a species was reported by different people. No attempt was made to weight species by major or minor values. We excluded species mentioned by fewer than 10 respondents in the use value analysis.

Results

Respondents interviewed in this study belonged to different ethnic backgrounds, with the Banyankole (95%) and Lugbara (69%) as the dominant tribes in Kiruhura and Arua districts, respectively. The respondents appear to be socially and economically marginalized based on the low level of formal education; most respondents (85%) had attained only primary level education. Respondents' main source of livelihood was crop (61%) and livestock (28%) farming. The average age of the respondents was 42 years (range 18–84 years). Most respondents belonged to male-headed homesteads (87%) and were almost exclusively Christians. Farmers' plot sizes had a median area of two acres in Arua (range 0.25–7 acres) and 36 acres in Kiruhura (range 1–250 acres). Most respondents (84%) owned the land that they farmed on. Those who did not own land subsisted on land belonging to their relatives.

Priority species

During the group interviews we determined that the priority needs that farmers desired to be satisfied from trees (see Table 2). Respondents in this study mentioned 138 species that they considered to be useful. There were differences in species mentioned and also frequencies of mention by district. We distinguish in this study between

Table 2. Ranked household needs that farmers feel can be satisfied by tree products in selected villages of Arua and Kiruhura, Uganda. The needs are ranked with 1 as the most important need.

Needs	Arua	Kiruhura
Food (edible fruits)	1	1
Building (poles)	2	
Income generation	3	2
Environmental protection	4	4
Wind break	5	
Firewood	6	5
Future generation	7	
Shade	8	3
Timber	9	
Medicine	10	4
Maintain soil structure and fertility		5

Table 3. Species that farmers wish to plant in the future in selected villages of Arua and Kiruhura, Uganda. Only species mentioned by nine or more respondents are shown.

Species	Arua	Kiruhura	Total
Eucalyptus spp.	61	52	113
Mangifera indica L.	46	29	75
Persea americana Mill.	54	19	73
Artocarpus heterophyllus Lam.	43	12	55
Carica papaya L.	23	8	31
Citrus sinensis (L.) Osbeck	5	23	28
Citrus limon (L.) Osbeck	25		25
Pinus spp.	3	12	15
Annona senegalensis Pers.	12		12
Tectona grandis L.f.	9		9

useful species mentioned by all respondents and priority species determined after analysis of the data. We determined priority species by combining species with the highest use value (Appendix 1) with species that farmers are willing to plant in the future and/or those that are currently sold. From this analysis, the 10 priority species that farmers value most are reported in Table 3. *Annona senegalensis* Pers, *Pinus* spp., and *Tectona grandis* L.f. were not frequently mentioned among useful species, but farmers frequently mentioned them among the species they wished to plant in the future.

Species mentioned by 10 or more respondents and their computed use values are shown in Appendix 1. This means that the most valued species are appreciated for their edible fruit, as based on their prioritized use values. The priority species are multipurpose, with *Eucalyptus* spp. having the largest number of uses. *Pinus* spp., *Eucalyptus*, and *T. grandis* are valued for their (construction) wood and timber. All species except *Carica papaya* L. can be used as firewood, but the topmost firewood species are *Eucalyptus* spp. All priority species are introduced but naturalized, existing as semi-wild. By semi-wild we mean species that are self-regenerating and are minimally affected by landscape use by farmers.

Some tree products are sold to earn incomes. Edible fruits are the most commonly sold tree products. The commonly sold species are *Persea americana* Mill., *Eucalyptus* spp., *Mangifera indica* L., *Artocarpus heterophyllus* Lam., *C. papaya*, *Citrus sinensis* (L.) Osbeck, and *Citrus limon* (L.) Osbeck. Poles of *Eucalyptus* spp. are sold by farmers in Arua District. The products are sold at farmers homes (n = 94; 52%) while poles are sold in designated markets (n = 73; 40%). It was not easy to determine the frequency of selling products, apart from edible fruit that are sold twice a year on average following seasonal availability. Everybody, including children, can sell tree products, for the two study areas combined, although adults are more involved (women 43%, men 42%, children 15%).

Availability of tree species

We determined the availability of woody species based on respondents' perceptions and through an ecological inventory. In the surveys we asked respondents to list species that are known to be scarce or are declining and those that are increasing or becoming abundant. For each species we compared frequencies (decreasing/increasing) and took the greater of the two frequencies to come up with the availability status of a species (Table 4). Based on respondents' perceptions, 7 of the 10 priority species (all edible fruit trees) are abundant or available in Arua District, but not in Kiruhura. The other three species are scarce in both districts. Species that are perceived to be abundant in Kiruhura are mostly indigenous and not priority species. Abundance of species is attributed to easy natural regeneration (26%). Other factors include planting (23%) or protection (17%) by farmers when found growing naturally. Additional factors are that such species are either not exploited or are exploited at very low intensities (17%) or their seedlings are readily available (6%). Conversely, species known to be disappearing appear not to be planted or not to be protected by farmers.

Overall, trees face many threats, key among which is destructive exploitation to get products such as fuelwood (69.5%), clearing land for agriculture (19%), pests (8%), and destruction by wild animals (3%).

Tree management

Respondents in the study area are interested in maintaining trees and are actively involved in their planting and management. All respondents who participated in this study had planted a tree in the last five years and were willing to plant more in the future. When asked which species they wished to plant in the future, they mentioned the species shown in Table 4. The list is made up mostly of edible species, such as *M. indica*. It also includes *Eucalyptus* spp., valued for poles for building, for firewood, and for income generation. The common tree management practices included protecting juvenile trees against damage (39%), planting (39%), or pruning to encourage re-sprouting (8%).
Trees are primarily propagated from seedlings prepared by farmers or purchased from nursery gardens (Tables 5, 6). Trees are primarily planted in cultivated areas (Ta-

Table 4. Woody species availability status based on respondent perceptions in selected villages of Arua and Kiruhura, Uganda. The statuses were evaluated on the balance of frequencies of perceptions of scarcity and abundances by respondents. Exotic species are those species that were introduced but which cannot regenerate without farmer intervention, while naturalized species can regenerate and establish without farmer intervention. Status: abundant (**A**), declining (**D**). History of introduction and adaptability: introduced (**IT**), naturalized (**N**), indigenous (**ID**), exotic (**E**).

Plant name	Abundant			Scarce			Status	History of introduction & adaptability
	Arua	Kiruhura	Total	Arua	Kiruhura	Total		
Eucalyptus spp.	91	8	99	3	30	33	A	IT
Mangifera indica L.	68	8	76	11	8	19	A	N
Persea americana Mill.	50	6	56	5	1	6	A	N
Searsia natalensis (Bernh. ex C.Krauss) F.A.Barkley		56	56	1	1	2	A	ID
Acacia hockii De Wild.		39	39		10	10	A	ID
Acacia gerrardii Benth.		35	35		4	4	A	ID
Grewia spp.		28	28		5	5	A	ID
Artocarpus heterophyllus Lam.	25	1	26	5	5	10	A	N
Acacia sieberiana DC.		22	22	7	2	9	A	ID
Albizia coriaria Welw. ex Oliv.		22	22				A	ID
Carica papaya L.	18	3	21	2	1	3	A	N
Olea europaea subsp. *cuspidata* (Wall. & G.Don) Cif.		21	21		3	3	A	ID
Markhamia lutea (Benth.) K.Schum.	15		15		2	2	A	ID
Vepris nobilis (Delile) Mziray		14	14		2	2	A	ID
Citrus limon (L.) Osbeck	13		13	4		4	A	N
Carissa spinarum L.		10	10	6	1	7	A	ID
Ficus spp.		9	9		3	3	A	ID
Scutia myrtina (Burm.f.) Kurz		9	9		1	1	A	ID
Ekyikobokobo		8	8				A	ID
Annona senegalensis Pers.	6		6	1		1	A	ID
Euphorbia conspicua N.E.Br.		6	6				A	ID
Lantana camara L.		6	6				A	N
Omunyinya		6	6				A	ID
Citrus sinensis (L.) Osbeck	4	1	5		11	11	D	N
Combretum molle R.Br. ex G.Don		3	3	13	5	18	D	ID
Pinus spp.		1	1	3	13	16	D	E
Terminalia brownii Fresen.	5		5	12		12	D	ID
Tamarindus indica L.	3		3	7		7	D	ID
Ximenia americana L.		1	1	4	1	5	D	ID

ble 7). The responsibility of managing trees is shared by all family members, including children, with adults taking the greatest share of the responsibility (Table 8). Trees are maintained in crop fields/livestock farms, around the home, in the home-garden, or the compound. Few respondents receive information on tree planting, but for those who do, their chief source of information is the radio (50%) or the British American Tobacco company in Arua (16%), or from other community members (16%).

Trees are owned by men in the family. However, other community members have usufruct rights to all tree products including edible fruits, poles, and fuelwood. With such widespread easy access to tree products it is proba-

Table 5. Tree germplasm in selected villages of Arua and Kiruhura, Uganda.

Germplasm	Arua	Kiruhura
Seedlings	299	89
Stem cuttings	17	7
Wildings		2
Root suckers	1	

Table 6. Tree sources in selected villages of Arua and Kiruhura, Uganda.

Source	Arua	Kiruhura
Bought (seedlings/seeds)	143	25
My land (seeds and wildings)	58	27
Neighbor	76	31
Self	32	13
British American Tobacco	15	
Relative	12	
Non-Governmental Organizations	5	
Roadside	5	
Bushland	1	
National Agricultural Advisory Services		1
School		1
Sub county		1

Table 7. Land use unit where trees are planted in selected villages of Arua and Kiruhura, Uganda.

Land use unit planted on	Kiruhura	Arua
Court yard	56	160
Field garden	52	122
Backyard	2	100
Livestock farm	161	
Forest	1	
Hedge	9	
School courtyard	6	

Table 8. Family members responsible for planting in selected villages of Arua and Kiruhura, Uganda.

Responsible for tree planting	Arua	Kiruhura
Husband	68	51
Wife	38	28
Children	19	12
Hired labor	3	9
Administration		1

bly difficult to sell tree products amongst community members, and clients have to come from outside the villages.

Constraints against tree planting

Farmers who did not plant trees were asked to give reasons that constrain their tree planting activities, and according to them, the major reasons are livestock or wild animal destruction of trees (20%), land shortage (19%), drought (18%), and lack of money to manage trees (12%). Destruction of trees by animals and drought were mentioned most frequently by people of Kiruhura District. Kiruhura is a pastoral community close to a National Park in an area of low rainfall where farmer livelihoods are dependent on livestock rearing. Kiruhura farmers own large plots of lands, and land shortage was more frequently mentioned by farmers in Arua than in Kiruhura District. Additional frequently mentioned factors were pest infestations (10%), lack of seedlings (8%), and lack of labor (5%).

Respondents made suggestions for improving tree cover that included protection of trees against destruction (40%), promotion of tree planting (32%), and employing good agronomical practices (16%). When asked which help they wished for strengthen their tree planting ability, they requested access to seedlings (30%), financial services (22%), agricultural inputs such as pesticides (18%), and land (6%).

Discussion

Tree values and priority species

Effective tree planting in anthropogenic landscapes requires close collaboration with farmers because farmers control important inputs for tree planting such as land and also make decisions such as whether trees should be planted on their land or not and which species should be planted and managed. According to the livelihood strategy theory, such decisions are influenced by the existing family needs and availability of capital, labor, and land (Scherr 1995, Warner 1995). Farmers' participation is also influenced by the existing tree management practices and systems, agroecological conditions, and constraints to tree planting.

In this study we have determined the key needs farmers want to satisfy by growing and managing trees: the production of edible fruits, opportunities for income generation, and increased access to construction wood, in that order of decreasing importance. There were differences in species mentioned and the frequencies of mention for the species between the two study districts, most probably owing to geographical and cultural differences. We have also prioritized 10 species that farmers value most, and these are mostly exotic, edible fruit trees. Farmers' household needs to be satisfied by trees in our study are simi-

lar to those reported for farmers elsewhere. For example farmers in east and southern Africa reportedly planted exotic/introduced edible fruits trees (Warner 1995). Additionally, species similar to those prioritized here have been highlighted in other parts of Uganda. For instance, Tabuti (2012) in his inventory in Balawoli District came up with similar species to those reported here. *Eucalyptus* spp., the most important firewood species in this study, was prioritized as one of the most suitable species for commercialization for firewood by Baldascini (2002). Species that are valued in many parts of the country lend themselves to rapid acceptance by farmers over the whole country and should be prioritized over other species in reforestation or afforestation programs.

An additional characteristic of the priority species is that they are multipurpose and are valued in different contexts including use as food (edible fruits), firewood, and income generation. Multipurpose species are preferred over single-use species because they provide better options to satisfy different household needs and offset household vulnerabilities to changing market conditions (Scherr 1995).

Tree management and challenges

In this study we have determined the tree management system and existing challenges to tree planting. Farmers are interested in planting trees and as shown above are interested in exotic fruit trees. Trees are managed and maintained by adult members in the household around the homestead in the courtyard or the backyard and in crop fields and livestock farms. They are not maintained in farm borders, albeit an important land use unit in farmer-inhabited landscapes. Farm borders or hedgerows are used by Kenyan farmers with little land (Backes 2001).

The key challenges to tree management included livestock and/or wild animal destruction of trees, especially in Kiruhura, a pastoral area. Livestock damage is a common limiting factor to tree planting and one which forces farmers to manage and plant trees in protected areas around homesteads such as in the homegarden, compound, or other protected areas. Thus planting of trees near the homestead reflects scarcity of land on the one hand or a strategy to protect trees against livestock browsing on the other (Arnold & Dewees 1995). Another common solution to the challenge of livestock grazing of trees is to plant species that are not favored by livestock such as *A. hockii* (considered a weed in Kiruhura).

The other key challenges negatively affecting farmers' tree planting activities are land shortage, drought, lack of financial resources (capital) to manage trees, pests, lack of seedlings, and labor. Labor restrictions are expected to result in increased tree planting because intensification of tree planting is an attractive option for farmers with large land holdings and no labor to manage the land or supervise crop production (Arnold & Dewees 1995). Farmers with little labor have problems managing crops and find it easier to plant trees which have fewer constraints for labor and inputs. For such farmers, tree planting increases productivity of idle land while securing the tenure of the holding.

Conclusions

Farmers of Kiruhura and Arua districts are interested in planting trees to get access to edible fruits and construction wood to increase opportunities for income generation. Ten woody species out of 138 useful ones have been prioritized in this study. The priority species are introduced, multipurpose, and valued mostly for their edible fruits. Timber is not among the products desired among the priority species in the study communities. Some species such as *Eucalyptus* spp. have income-generating potential, and their products are sold in the area and generate incomes for farmers. The market for tree products, especially edible fruits, is small and informal, and there is need to develop it.

Farmers are interested in tree planting and are actively involved. Trees are managed in home gardens, courtyards, and crop fields and livestock farms. Farm borders, an important land use unit for tree planting, is not exploited in the study area. The key challenges to tree planting are livestock or wild animal destruction of trees, land shortage, drought, and lack of money. An opportunity to overcome these challenges exists in the positive policy environment, e.g., the National Development Plan of Uganda (National Planning Authority 2010) and institutions such as National Forestry Authority (NFA) or the Sawlog Plantation Grant Scheme (SPGS).

Recommendations

We recommend that the priority list of trees identified here forms the focus of re/afforestation programs in anthropogenic landscapes of Uganda and that alley or border cropping should be promoted to overcome the challenge of land scarcity. The markets for edible fruits needs to be developed but is hampered by inadequate information on aspects such as value chain and main actors. There is need therefore to conduct a market study to determine the market value chain of tree products in these and other parts of Uganda as a means to improve the marketing of tree products. This will strengthen tree products markets and provide a decent return on tree management investment.

Community level tree nurseries need to be established to extend access to seedlings of priority tree species. Further research on propagation behavior of, and provenance studies on, woody species, especially indigenous ones, should be conducted to determine the best stock to

use to improve production of seedlings. It will also be important to determine why species such as *P. americana* and *C. papaya* are not common in Kiruhura District.

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Appendix 1. Important tree species of Arua and Kiruhura districts and their use values. Only species mentioned by 10 or more respondents in interviews are shown. The highest use values are highlighted in red font.

Species	Total use value	Use value categories												
		Boat making	Browsing	Buiilding	Charcoal	Crafts	Edible fruit	Environment	Feed trough	Fencing	Firewood	Furniture	Hedges	Income
Eucalyptus spp.	1.07	0.01	0.01	0.38	0.01			0.01	0.01	0.01	0.27	0.01		0.11
Mangifera indica L.	0.88						0.72				0.06			0.08
Persea americana Mill.	0.73			0.01			0.6				0.03			0.1
Carica papaya L.	0.45						0.38				0.01			0.04
Citrus limon (L.) Osbeck	0.44						0.33				0.01			0.09
Artocarpus heterophyllus Lam.	0.44						0.31				0.01			0.1
Markhamia lutea (Benth.) K.Schum.	0.43		0.01	0.11							0.15	0.01		0.01
Grewia spp.	0.3		0.01	0.04						0.01	0.03	0.01		
Acacia gerrardii Benth.	0.29			0.01	0.03			0.01		0.01	0.09			
Searsia natalensis (Bernh. ex C.Krauss) F.A.Barkley	0.28		0.02	0.02	0.01		0.01	0.01		0.01	0.06			
Psidium guajava L.	0.28			0.01			0.23				0.02			0.03
Acacia sieberiana DC.	0.23		0.01	0.01	0.01	0.01			0.02	0.01	0.1			
Albizia coriaria Welw. ex Oliv.	0.2	0.01						0.01	0.02	0.01	0.01			
Acacia hockii De Wild.	0.19		0.01	0.02	0.03					0.01	0.07			
Tamarindus indica L.	0.17						0.1				0.01			0.02
Citrus sinensis (L.) Osbeck	0.17						0.15							0.01
Diospyros abyssinica (Hiern) F.White	0.15						0.12				0.01			0.03
Ficus thonningii Blume	0.14		0.01					0.01			0.07			0.01
Olea europaea subsp. *cuspidata* (Wall. & G.Don) Cif.	0.13			0.01						0.01	0.01			
Annona senegalensis Pers.	0.13						0.09				0.03			0.01
Vitex doniana Sweet	0.11						0.07				0.04			
Ficus mucuso Welw. ex Ficalho	0.1				0.01						0.07			
Melia azedarach L.	0.1			0.02							0.03	0.02		
Ficus spp.	0.1	0.01		0.02			0.01			0.01			0.01	0.01
Carissa spinarum L.	0.09						0.07			0.01	0.01			
Cupressus lusitanica Mill.	0.08			0.01								0.01		
Pinus spp.	0.08										0.01	0.01		
Vepris nobilis (Delile) Mziray	0.08			0.02							0.01			
Syzygium cumini (L.) Skeels	0.08			0.01			0.04			0.01	0.02			0.01
Combretum molle R.Br. ex G.Don	0.07			0.01	0.01						0.06			
Tectona grandis L.f.	0.07			0.01										
Erythrina abyssinica Lam.	0.07									0.01	0.02			
Ficus amadiensis De Wild.	0.07										0.06			
Ziziphus abyssinica Hochst. ex A.Rich.	0.06				0.01	0.01				0.02	0.03			
Vernonia amygdalina Delile	0.06													
Vitellaria paradoxa C.F.Gaertn.	0.06						0.05				0.01			
Terminalia brownii Fresen.	0.06				0.01						0.04			

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Appendix 1 (cont). Important tree species of Arua and Kiruhura districts and their use values. Only species mentioned by 10 or more respondents in interviews are shown. The highest use values are highlighted in red font.

Species	Use value categories												
	Medicine	Paddocks	Poles	Rain formation	Shade	Soil fertility	Soil moisture	Soil protection	Timber	Tobacco curing	Toothbrush	Walking Stick	Windbreak
Eucalyptus spp.	0.01	0.01	0.03	0.01	0.03	0.01			0.13	0.02			0.01
Mangifera indica L.					0.02								
Persea americana Mill.									0.01				
Carica papaya L.	0.01				0.01								
Citrus limon (L.) Osbeck	0.01												
Artocarpus heterophyllus Lam.					0.01								
Markhamia lutea (Benth.) K.Schum.	0.01	0.01	0.01		0.02				0.1				
Grewia spp.	0.01	0.02	0.03		0.09		0.01					0.03	0.02
Acacia gerrardii Benth.		0.02	0.01		0.11		0.01	0.01					
Searsia natalensis (Bernh. ex C.Krauss) F.A.Barkley	0.03	0.02	0.01		0.06	0.01	0.01				0.02	0.01	
Psidium guajava L.													
Acacia sieberiana DC.					0.06		0.01						
Albizia coriaria Welw. ex Oliv.	0.02				0.09		0.02	0.01	0.03				
Acacia hockii De Wild.	0.02				0.03								
Tamarindus indica L.	0.03												
Citrus sinensis (L.) Osbeck					0.01								
Diospyros abyssinica (Hiern) F.White													
Ficus thonningii Blume					0.05								
Olea europaea subsp. *cuspidata* (Wall. & G.Don) Cif.	0.01	0.02	0.03		0.06								0.01
Annona senegalensis Pers.													
Vitex doniana Sweet													
Ficus mucuso Welw. ex Ficalho				0.01	0.01				0.01				
Melia azedarach L.									0.03				
Ficus spp.			0.01		0.02	0.01			0.02				
Carissa spinarum L.	0.01												
Cupressus lusitanica Mill.				0.01	0.01				0.06				0.01
Pinus spp.			0.01		0.01				0.04				0.01
Vepris nobilis (Delile) Mziray		0.01	0.01		0.02				0.01			0.01	
Syzygium cumini (L.) Skeels													
Combretum molle R.Br. ex G.Don	0.01												
Tectona grandis L.f.				0.01					0.05				0.01
Erythrina abyssinica Lam.	0.02	0.01	0.02		0.01								
Ficus amadiensis De Wild.					0.01								
Ziziphus abyssinica Hochst. ex A.Rich.													
Vernonia amygdalina Delile	0.06												
Vitellaria paradoxa C.F.Gaertn.													
Terminalia brownii Fresen.					0.01								

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