Important Woody Plant Species, their Management and Conservation Status in Balawoli Sub-county, Uganda

John R.S. Tabuti

Research

Abstract

Woody plant species are threatened in Uganda. To conserve these species there is need to generate information that may be used to design management plans. This study was conducted in Balawoli Sub-county, Kamuli District, Uganda between July 2009 and January 2010. We addressed four questions: (1) which woody species are most preferred? (2) what is the conservation status of these species and for which species have changes in local availability been observed? (3) what management practices exist for woody species? and (4) what tenure rights exist for woody plants? Data were generated through guided questionnaire interviews. Seventeen species are valued most within the community. These species are multipurpose and altogether have 25 different uses for the community. The most frequently harvested products are edible fruits, firewood and timber. The value of these species as a source of income is low. *Milicia excelsa* (Welw.) C.C. Berg, *Albizia coriaria* Welw. ex Oliv., *Combretum molle* R. Br. ex G. Don, *Terminalia glaucescens* Planch. ex Benth., *Coffea* spp., *Combretum collinum* Fresen. and *Citrus* spp. are becoming scarce. However, *Artocarpus heterophyllus* Lam., *Mangifera indica* L., *Ficus natalensis* Hochst., *Citrus sinensis* (L.) Osbeck, *Acacia* sp., *Senna siamea* (Lam.) H.S. Irwin & Barneby, *Eucalyptus* spp., *Pinus* spp., *Carica papaya* L. and *Lantana camara* L. are increasing in abundance. The main factors leading to the scarcity of some species include over-harvesting, destructive harvesting, pests, poor planting of trees by farmers, and droughts. The key factors contributing to some species' success are that the species are: planted, drought resistant, regenerate naturally, easy to manage, mature fast, available as seedlings. Farmers maintain 51 woody species that they plant or retain when found growing naturally on their land. Some farmers are constrained in planting trees by lack of seedlings, pest infestations, drought and lack of land. Species are managed in crop fields, the courtyard and home garden. Men own trees in the homestead, are more involved in tree management and selling of tree products, than women.

Introduction

Woody species, i.e., trees and shrubs, are threatened in many different parts of the world (Augusseau *et al*. 2006). It is estimated that 10% of all tree species are threatened (Williams 1998). The highest rates of woody species loss are in the tropics (FAO 2009). Estimates suggest that in Uganda 0.9 – 3.15% of the forested area disappears every year and that the forested areas have shrunk from 52 to 24%, in the last 100 years (NEMA 2002, UNDP 2007). The major causes of woody species loss are linked to rapid human population growth rates and poverty (Jha & Bawa 2006, FAO 2009). These drivers force people to harvest woody species using poor methods and at unsustainably high intensities; to expand crop agriculture into woody species habitats; and to shorten fallows that are

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necessary for woody species reestablishment (Augusseau *et al*. 2006, Baillie *et al*. 2004).

Rural and marginalized households are highly dependent on woody plants for their subsistence and income generation (Marshall & Newton 2003, Shackleton *et al*. 2001). For instance, in Uganda, more than 90% of the homesteads use wood fuels (NEMA 2002). The loss of woody plants that supply products that are important for local subsistence or income generation can, therefore, cause untold suffering among people who have traditionally relied on them to satisfy their needs (Primack 1998, Shackleton *et al*. 2001, Walter 2001). This is especially true for women (Marshall & Newton 2003, Upadhyay 2005). Across Africa, women care for their families and are responsible for gathering firewood for cooking. Firewood scarcities are likely to increase their burden at a time when men are increasingly emigrating to towns and transferring their activities, such as small ruminant herding, to women (Djoudi & Brockhaus 2011, Kiptot & Franzel 2011)

To safeguard livelihoods and reduce poverty among communities that are dependent on naturally growing plants, it is important that the species they depend on are sustainably managed. For woody species to be effectively managed and conserved, farmers must be involved because of two reasons. First, over 70% of woody species, including tree resources, are on private land owned by farmers (NEMA 2002). Second, decisions regarding which species are selected for maintenance (or destruction) are made by farmers at the household level basing on how much a household will benefit from growing a particular species and how such a species fits in the household's labor and input requirement (e.g., land) (Dalle & Potvin 2004, Simons & Leakey 2004, Warner 1994). For this collaboration with farmers to contribute successfully to species conservation and planting, there must be a clear understanding of which species are highly valued by farmers (Warner 1994). The identification of species preferred by individual households is decisive to tree and other woody species management because farmers will only invest in such species, if the selected trees provide them with clear benefits.

However, there are woody species that are threatened but which must be managed by the state or the local governments. These include: 1) species valued by farmers, but for which farmers lack the essential skills and capital resources to manage; 2) species that are important to only a small section of the community, e.g., medicinal plants; and 3) species not highly preferred by farmers but which must be conserved to maintain ecosystem services such as flood control (Chan *et al*. 2006, Díaz *et al*. 2006).

The aim of this study was to generate information that would contribute to the design of robust management plans for the conservation, and increase, of woody species cover in Uganda by conducting a case study in Balawoli Sub-county. The study was guided by the following key questions:

1. Which species are most preferred in Balawoli Sub-county?
2. What is the conservation status of woody plant species and for which species have changes in local availability been observed?
3. What management practices exist for woody species in the landscape? and,
4. What tenure rights exist for trees?

Methods

Fieldwork for this study was conducted in Balawoli Sub-county, of Bugabula County in Kamuli District. Balawoli Sub-county is about 200 km from Kampala, the capital city of Uganda, and is located between 32° 93' – 33° 15' E and 2° 81' - 3° 04' N (Figure 1), at an altitude of 1060 m above sea level. This study was conducted between July 2009 and January 2010 using ethnobotanical techniques described in the next paragraph. Respondents were selected using a multi-stage sampling procedure based on the local administrative units. The local administrative units in Uganda, from highest to lowest are county, sub-county, parish and village. Balawoli sub-county was randomly selected from the eight sub-counties of Bugabula County. In turn, four parishes were randomly selected from Balawoli sub-county (Figure 1). From each parish, four villages were again randomly selected, to make a total of 12 villages (Bugaya, Bugaga, Bandali, Buganza Bunampogo, Bukayibaale, Bukitimbo, Bulinda, Bulumaga buteila, Butoigo Bulwile, Buwaiswa, Nabitalo A. and Nambale). In every village, we generated a list of all inhabitants to use as a sampling frame, with the help of the local area politician (Local Council I, Chairperson). From this list 20 households were selected for inclusion in the interviews. We interviewed 238 people; of whom 133 were male. All respondents were paid a token fee at the end of the interview as compensation for their time.

A guided questionnaire was used in face-to-face interviews. The interviews were designed to determine what the most preferred woody species were and which species people were selling. They also investigated the existing tree management practices, constraints people faced when managing trees, which opportunities existed for tree management, and who owned trees in the homestead. Lastly, respondents were requested to list species that were becoming locally scarce, those that were becoming more abundant and what factors had contributed to these changes. Demographic data were collected for all respondents. Direct observations were made on issues relevant to the study objectives, such as destructive harvesting of trees and vegetation types. Plant species were identified in the field. Voucher specimens of these species were collected and deposited in Makerere University Herbarium (MHU).

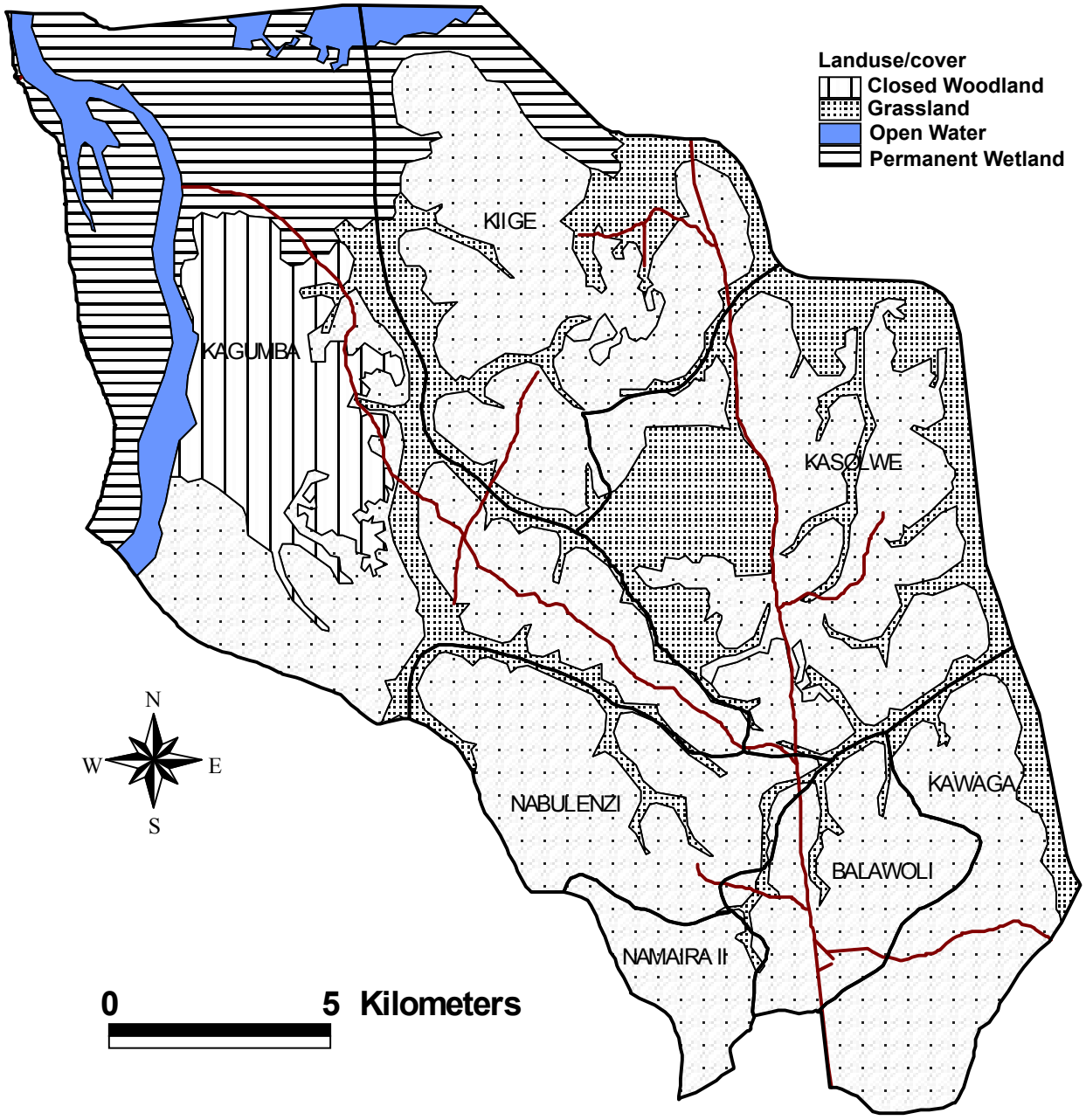

Figure 1. Balawoli Sub-county, Kamuli District, Uganda showing the land use types and parishes. Research was conducted in Balawoli, Kagumba, Kibuye and Namaira Parishes.

All survey data were entered in Microsoft Office Excel spreadsheets, checked for errors, and edited before coding and importing into SPSS version 12 (SPSS 2003) for analysis. Frequencies and percentages were generated by SPSS and presented in tables or figures.

Results

Biographic details

The respondents had an average age of 39 years (range 16 – 93). The majority of the respondents had attained only primary level of formal education (equivalent to 7 years or less) (Table 1). The main source of livelihood for the respondents was crop farming. Other respondents were engaged in livelihood activities such as retail trade. The respondents were mostly Christian by religion and Basoga by tribe and belonged to male-headed households. Most of them owned the land that they farmed (94.1%) with close to 65% owning ≤ two hectares of land (Table 2).

Table 1. Respondents' biographic details in Balawoli Sub-county, Kamuli District, Uganda.

Attribute	%	Attribute	%
Education		Tribe	
None	22.6	Musoga	71.3
Primary	58.4	Mukenye	11.0
Secondary	17.7	Munyoro	5.9
Tertiary	0.9	Atesot	5.5
Adult education	0.4	Muganda	3.4
Household head occupation		Musamya	0.8
		Mutooro	0.8
Farming	68.8	Luo	0.4
Retail trade	8.9	Mugwere	0.4
Fishing	6.3	Munyara	0.4
Teaching in local school	2.1		
Cycle transporter	1.7	Religion	
Other artisanal activities	12.2	Protestant	38.0
Household head's sex		Catholic	37.6
		Moslem	13.2
Male	91.6	Adventist	6.0
Female	8.4	Pentecostal	3.8
		Traditionalist	1.3

Table 2. Estimated farm size holding by farmers in Balawoli Sub-county, Kamuli District, Uganda.

Estimate of farm area	%
very small (<0.4 ha)	15.5
small (0.4 – 0.9 ha)	28.4
intermediate (1 - 2 ha)	20.6
large (larger than 2 ha)	23.2
very large (larger than 15 ha)	12.3

Priority woody species of Balawoli Sub-county

Sixty-nine species were valued within the community (Appendix 1). Seventeen of these were mentioned more frequently (by more than 30% of the respondents), and were therefore considered as the most important (Table 3). These priority species were multipurpose, commonly having more than three uses. Taken altogether, these species had 25 different values for the community. The most frequently harvested products from the woody species were edible fruits, firewood and timber (Figure 2, Table 3). These products were used in the home for subsistence or were infrequently sold to earn cash incomes (Table 4). The people also valued the provision of shade by trees. The value of these species as a source of income was rarely mentioned (only 4% of the respondents), although 49% of the respondents claimed to have sold some woody products.

Table 3. Priority woody species of Balawoli Sub-county, Kamuli District, Uganda. Products shown are based on species mentioned by respondents asked about useful species, those who claimed to have sold products and those intending to plant the species in the future. A main product is considered to be that mentioned by at least 50% of the people or the most frequently mentioned use for the species. Only products mentioned by 2 or more people are included here.

Species	Products		Proportion (%) of respondents:		
	Main	Other	mentioning preference for species	claiming to have sold product	wishing to plant this species
Mangifera indica L.	Edible fruit, Firewood	Medicine, shade, income, charcoal	99	14.3	9.5
Maesopsis eminii Engl.	Timber, firewood	Income, poles, shade, soil fertility, medicine	84	4.6	21.2
Artocarpus heterophyllus Lam.	Edible fruit	Firewood, timber, shade	83	17.2	4.7
Citrus sinensis (L.) Osbeck	Edible fruit	Firewood, income	72	21.0	10.3
Milicia excelsa (Welw.) C.C. Berg	Timber	Firewood, charcoal, construction, shade, rain formation, medicine	87	7.1	4.7
Ficus natalensis Hochst.	Shade	Bark cloth, fodder, firewood, timber, Edible fruit, poles, charcoal, windbreaker	68	1.7	3.0
Coffea spp.	Income	Edible fruit	32	10.9	5.2

Species	Products		Proportion (%) of respondents:		
	Main	Other	mentioning preference for species	claiming to have sold product	wishing to plant this species
Eucalyptus spp.	Timber	Poles, firewood, income, medicine, windbreaker	34	1.3	8.4
Albizia coriaria Welw. ex Oliv.	Timber	Firewood, charcoal, Construction, Medicine	43		0.5
Pinus spp.	Timber	Income, firewood, Edible fruit	25		16
Persea americana Mill.	Edible fruit	Firewood, medicine	32	3.8	2.3
Carica papaya L.	Edible fruit		31	2.1	0.7
Ficus sycomorus L.	Shade	Timber, firewood, charcoal, intercropping, construction, windbreaker	26		0.2
Senna siamea (Lam.) H.S. Irwin & Barneby	Firewood	Shade, poles, timber, beautify compound	23		1.6
Markhamia lutea (Benth.) K. Schum.	Poles	Firewood, timber, shade	21	1.7	0.7
Citrus reticulata Blanco	Edible fruit	Medicine	16	4.6	1.6
Citrus limon (L.) Osbeck	Edible fruit	Medicine, firewood, timber, income	17	3.4	0.9

Marketing of tree products

49% of the respondents claimed they sold products from 24 woody species in local markets (Appendix 2). Table 4 shows the most frequently mentioned species (cited by 9 or more people). Edible fruits from these species were sold once or twice a year, and timber infrequently. The products were sold to fellow villagers or to traders. A few respondents also mentioned processed products such as furniture, timber, and firewood. All family members are involved in selling of products, but husbands dominate in the activity (Table 5).

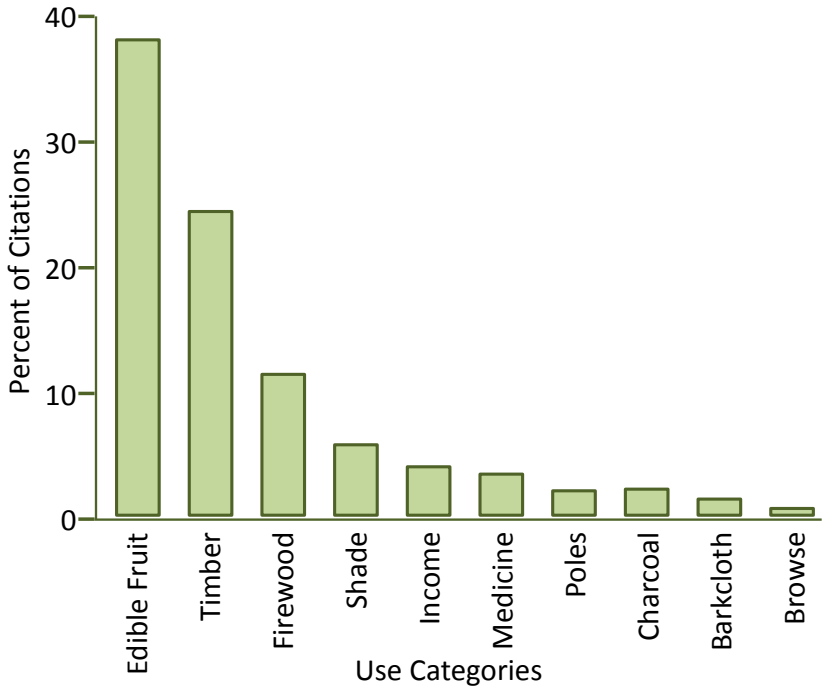

Figure 2. Major uses of woody species in Balawoli Sub-county, Kamuli District, Uganda. Only uses cited by more than 1% of the respondents are shown.

Species conservation statuses

Respondents were asked to list species they thought were declining in availability and those they thought were increasing. For the same species, there were respondents who thought that the species was declining, while other respondents thought otherwise. For every species, the frequencies for increase were compared with those for decrease and the greater of the two frequencies taken as the status for the species. For example, *Milicia excelsa* (Welw.) C.C. Berg was perceived to be declining by 86% of the respondents and to be increasing by 14% (Table 6). From this

Table 4. Commonly sold tree products, clients and frequency of selling tree products in Balawoli Sub-county, Kamuli District, Uganda. All species shown, apart from M. excelsa and *M. eminii*, yield edible fruits

Species	Middlemen	Fellow farmers	Total	%	Frequency of selling	
					Infrequent	1-2X/year
Citrus sinensis (L.) Osbeck	44	6	50	19.6		X
Artocarpus heterophyllus Lam.	28	13	41	16.1		X
Mangifera indica L.	28	6	34	13.3		X
Coffea spp.	24	1	25	9.8		X
Milicia excelsa (Welw.) C.C. Berg	7	9	16	6.3	X	
Citrus reticulata Blanco	11		11	4.3		X
Maesopsis eminii Engl.	4	6	10	3.9	X	
Persea americana Mill.	7	2	9	3.5		X

Table 5. Person responsible for selling woody products in the family in Balawoli Sub-county, Kamuli District, Uganda. [Only male-headed households selling tree products are considered (n=132). There were also 8 female-headed households involved in selling tree products.]

Responsible family member	Frequency	%
Husband only	79	59.9
Husband and wife	37	28.0
Wife only	12	9.1
All family members	2	1.5
Wife and children	2	1.5

comparison, the interpretation was that the perception is of a species declining. From this analysis (Table 6) six species are decreasing while 15 are increasing.

The key factors believed by respondents to be leading to species disappearance include destructive harvesting to produce charcoal, firewood, timber and poles; attack by pests; low propagation of trees; and droughts (Table 7). On the other hand, the species known to be increasing in abundance are successful because they are planted, are drought resistant, regenerate naturally, are easy to manage, mature fast, and their seedlings are available among other factors (Table 8).

Table 6. Respondents perception of woody species status in Balawoli Sub-county, Kamuli District, Uganda. Species status is taken to be the greater of the two frequencies. Species with fewer than 2 citations are excluded. Species with few citations are not included because it is difficult to determine status from such a low number of citations.

Species	Frequency of respondents claiming the species is:		Species status
	decreasing	increasing	
Milicia excelsa (Welw.) C.C. Berg	86	14	Decreasing
Albizia coriaria Welw. ex Oliv.	59	7	Decreasing
Combretum molle R. Br. ex G. Don	30	7	Decreasing
Terminalia glaucescens Planch. ex Benth.	22	2	Decreasing
Maesopsis eminii Engl.	19	92	Increasing
Ficus natalensis Hochst.	16	48	Increasing
Citrus sinensis (L.) Osbeck	11	19	Increasing
Coffea spp.	9	6	Increasing
Combretum collinum Fresen.	9	5	Decreasing
Eucalyptus spp.	7	18	Increasing
Citrus reticulata Blanco	6	2	Decreasing
Mangifera indica L.	6	52	Increasing
Artocarpus heterophyllus Lam.	4	56	Increasing
Ficus glumosa Delile	4	3	
Vepris nobilis (Delile) Mziray	4	3	

Carica papaya L.	4	10	Increasing
Acacia spp. (**mawa**)	3	8	Increasing
Acacia polyacantha Willd.	2	19	Increasing
Ficus sycomorus L.	2	4	
Lannea schweinfurthii (Engl.) Engl.	2	3	
Citrus limon (L.) Osbeck	2		
Persea americana Mill.	2		
Albizia zygia (DC.) J.F. Macbr.	3		
Vitex ferruginea Schumach. & Thonn.	2		
Senna siamea (Lam.) H.S. Irwin & Barneby		19	Increasing
Pinus spp.		16	Increasing
Lantana camara L.		10	Increasing
Senna spectabilis (DC.) H.S. Irwin & Barneby		6	Increasing
Markhamia lutea (Benth.) K. Schum.		4	Increasing
Thevetia peruviana (Pers.) K. Schum.		2	

Table 7. Factors reported by respondents in Balawoli Sub-county, Kamuli District, Uganda to be contributing to woody species decreasing availability.

Factor	Frequency
Charcoal burning	129
Harvested for timber	94
Pests	34
Harvested for wood to make canoes	17
Not planted	13
Drought	6
Poles	5
Firewood	5
High demand for products	4
Not drought resistant	3
Little benefit	3
Drain soils	2
Felled by winds	2
Easily dries up	1
Is a habitat for caterpillars	1
Dries up easily	1
Long period to maturity	1
No seeds and seedling	2
Not productive enough	1
Crop farming	1
Require a lot of care to grow	1

Table 8. Factors reported by respondents in Balawoli Sub-county, Kamuli District, Uganda to be contributing to woody species increasing availability

Factor	Frequency
Planted because it is useful	203
Seedlings or other propagules available	34
Drought resistant	32
Regenerates naturally	31
Easy to manage	28
Matures fast	26
Produce much seed	21
Wind dispersed	19
Not harvested for charcoal	17
Dispersed by birds	14
Promotion by government	6
Has market	5
Pest resistant	5
Not destructively harvested	4
Grows in swamps	4
Protected by thorns	1
Government restricts exploitation	1
Weed	1

Local tree management practices

Farmers stated that they were maintaining 51 trees species on their lands (Appendix 3). The farmers also said that they wanted to add more species on their farms (Table 3). Species were managed mostly in crop fields, courtyards, and home garden. Within the family, men were more involved in tree management (54%) compared to their wives 36.2% (Table 9). Tree species were either planted or retained by protecting wildings found growing naturally on farmers' land. Farmers themselves commonly propagated seedlings. Additional tree husbandry

Table 9. Tree management practices in Balawoli Sub-county, Kamuli District, Uganda.

Factor	%	Factor	%
Person responsible for tree management		Source of woody species seedlings	
Husband	54	Prepared by self	58.7
Wife	36.2	From neighbour	22.2
Children	8.5	Bought from nursery	14.7
Laborer	1.4	From neighbourhood	2.9
		National Agricultural Advisory Services (NAADS)	0.6
Tree tenure		From IRID (N.G.O)	0.4
Husband only	79.5	Distributed by LC5	0.2
Husband and wife	10.2	National Forestry Authority (NFA)	0.2
All family members	7.9	Uganda National Farmers' Association (UNAFA)	0.2
Wife only	2.3	Niche	
Propagation material for woody species		Garden	64.8
Seed	82.1	Courtyard	19.3
Wildings	10	Homegarden	12.8
Cuttings	7.9	Hedge	2.9
		Everywhere	0.3

practices include protection of trees against damage and pruning to encourage sprouting. Trees, according to most respondents, belonged to the husband in the home. Farmers shared freely some of the products from trees (mostly edible fruits, firewood, medicines and wildings).

The most frequently mentioned and therefore main challenges faced by farmers were lack of seedlings, attacks by pests, drought and lack of land. Many farmers' suggested that improving access to water could mitigate the challenges to tree planting. In particular efforts should be made to introduce irrigation. They also suggested that there should be endeavors to control pests, and that tree nurseries should be created in, or close to their sub-county.

Farmers rarely sought advice or encouragement regarding tree management, but when they did the media (radio), village meetings and political leaders are important sources of this information (Table 10).

Table 10. Source of information regarding tree planting in Balawoli Sub-county, Kamuli District, Uganda.

Source of information	%
Radio	52.4
Local political leaders	25.6
Neighbors	6.9
National Agricultural Advisory Services (NAADS) program	4.9
Self help projects	2.8
Seminars	1.6
Books	0.8
Extension workers	0.8
National Forestry Authority (NFA) officials	0.8
Kamuli nursery centre	0.4
Ministry campaigns	0.4
National Environment Management Authority (NEMA)	0.4
Uganda National Farmers' Association (UNAFA)	0.4
Traditional knowledge	0.4
Action aid (NGO)	0.4
Husband	0.4
Television	0.4

Discussion

This study identified 17 most highly-valued and priority woody species. These species were either the most frequently mentioned, were sometimes sold, or people planned to add them to those already on their farms. The species were valued by the people of Balawoli for the same reason people in other areas of the developing world value such species, that is, they provide products valuable for peoples' subsistence, especially edible fruits, firewood and timber. The role of these species as a source of income was not very important. This is not surprising because few gathered products are traded in markets and it is usually marginalized people that trade in species for which well established markets do not exist (Shackleton *et al*. 2001, Styger *et al*. 1999). A few farmers mentioned ecosystem services from woody species, such as improving soil fertility.

Some of the priority species are known to be disappearing. The direct factors of destructive harvesting practices and over-harvesting, known by respondents to cause declines in species availability as well as the other underlying factors, that drive over-exploitation or deter widespread tree management (Table 7), are not unique to Balawoli and are quite widespread (Augusseau *et al*. 2006, FAO 2009, UNDP 2007). Some species were however increasing in availability according to local per-

ceptions. This study generated a useful checklist of desirable characteristics that make woody species desirable to farmers, which should be considered when deciding on which trees to promote with farmers. These include economic, biological (e.g., fast maturity), and ecological factors (e.g., drought resistance, early maturing) (Table 8).

To improve woody species conservation in Balawoli, concerned stakeholders, e.g., National Agricultural Advisory Services, should focus on the 17 most important species identified. Farmers are more likely to collaborate meaningfully in planting trees that have a clear benefit for them (Allen 1990, Kahurananga *et al*. 1993, Warner 1994). Species that are lowly valued may not be readily managed or planted by farmers and for such species the local government and other stakeholders need to take the lead.

The people of Balawoli are interested in, and are maintaining trees on their land because the trees have important values. Men dominate in all aspects of tree management; it is mostly men who plant and own trees, and sell tree products. It is not clear how tenurial arrangements at the homestead level affect tree growing in Balawoli. It is probable that women participate less in tree growing because of tenurial right issues or because they are more involved in more labor intensive regular work of planting food crops and managing the home. According to some authors, men's ownership of trees and the land on which trees grow may act as a disincentive for women to plant trees (Obonyo *et al*. 2008). On the other hand there are those who believe that tree tenure does not affect tree planting decisions at the homestead level.

Conclusion and recommendations

Farmers in Balawoli Sub-county value most highly 17 woody species. These species play significant roles in subsistence well being. The key products harvested from the species are edible fruit, firewood, timber and poles. Species are also valued for the provision of shade. Farmers maintain many woody species around the homestead. However, the survival status of some woody species is poor.

Efforts by extension workers and others interested in maintaining trees on farm should focus on the 17 priority species identified here. The key threats identified here; poor markets for tree products, destructive harvesting for timber and wood for construction, and charcoal making should be addressed to improve tree cover. In addition, the advantageous factors identified in the community such as willingness to plant trees should be enhanced. One specific and pragmatic action to stimulate tree planting should be to increase the motivation of farmers to plant trees by promoting and creating markets for tree products. Improvement of markets or creation of markets will call for investigations into value chains of selected species/products. Other issues that need attention are: identifying solutions to control insect pests, and improvements in access to water and to planting material. Regarding the improvement to planting materials, research should be undertaken to improve our understanding of the germination and seedling establishment behavior of the priority species by conducting investigations both in experimental gardens and on farms.

The tenurial rights of trees, whereby men own and manage trees, observed in this study may have an influence on tree planting. It is not clear whether the low involvement by women is affecting tree planting and management in the sub-county and this needs investigation.

The collaboration of farmers in tree planting is likely to lead to increased availability of the priority species without increasing woody species diversity. The protection of woody species diversity, therefore, remains the responsibility of the local administration. The local administration should undertake among other actions the reforestation of its district reserves and undertake tree planting on public lands such as road reserves.

Lastly, this study has been conducted in eastern Uganda, but the loss of woody plants is occurring all over Uganda. It is necessary to have this study replicated in different agro-ecological regions of Uganda in order to capture the entire diversity of priority woody species for the country.

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Appendix 1. Frequencies of uses of woody species in Balawoli Sub-county, Kamuli District, Uganda. The most frequently reported uses are highlighted.

Species [Family]	Common name	Edible fruit	Timber	Firewood	Shade	Income	Bark cloth	Fodder	Medicine	Poles	Charcoal	Construction	Wind breaker	Intercropping	Beautify compound	Rain formation	Rubber	Soil fertility	Fencing	Water retention	Bee keeping	Making soap	Mosquito repellant	Demarcating land	Total	%
Mangifera indica L. [Anacardiaceae]	**Muyembe**	**206**	1	15	3	3			4		2					1									235	98.7
Milicia excelsa (Welw.) C.C. Berg [Moraceae]	**Mvule**	1	**162**	16	5	1			2	1	7	6	1			4				1					207	87.0
Maesopsis eminii Engl. [Rhamnaceae]	**Musizi**	1	**140**	36	3	5	1		2	5		2	1	1			1	3	1						202	84.9
Artocarpus heterophyllus Lam. [Moraceae]	**Fene**	**182**	3	8	2	1					1														197	82.8
Citrus sinensis (L.) Osbeck [Rutaceae]	**Mucungwa**	**166**		3		2																			171	71.8
Ficus natalensis Hochst., [Moraceae]	**Mugaire/ Kiryanoni**	3	9	**27**	**52**		**37**	**20**		2	3		3	7		1									164	68.9
Albizia coriaria Welw. ex Oliv. [Fabaceae]	**Musita**	1	**70**	14	1				4	1	7	3				1							1		103	43.3
Eucalyptus spp. [Myrtaceae]	**Kalitunsi**		**40**	13	1	5			3	14			2			1	1								80	33.6
Coffea spp. [Rubiaceae]	**Coffee**	15				**61**																			76	31.9
Persea americana Mill. [Lauraceae]	**Ovacado**	70		5					2																77	32.4
Carica papaya L. [Caricaceae]	**Papali**	**74**																							74	31.1
Ficus sycomorus L. [Moraceae]	**Mukunu**		16	13	**20**						4	2	2	3						1					61	25.6
Pinus spp. [Pinaceae]	**Pine**	2	**39**	6		10			1				1		1										60	25.2
Senna siamea (Lam.) Irwin & Barneby [Fabaceae]	**Gassia seed**	1	6	**26**	8				1	7	1		1		3						1				55	23.1
Markhamia lutea (Benth.) K. Schum. [Bignoniaceae]	**Musamba/ Lusolwe**	1	10	13	3			1	1	**18**	1		1				1								50	21.0
Citrus limon (L.) Burm.f., Rutaceae	**Niimu**	**23**	1	2		1			15																42	17.6

Species [Family]	Common name	Edible fruit	Timber	Firewood	Shade	Income	Bark cloth	Fodder	Medicine	Poles	Charcoal	Construction	Wind breaker	Intercropping	Beautify compound	Rain formation	Rubber	Soil fertility	Fencing	Water retention	Bee keeping	Making soap	Mosquito repellant	Demarcating land	Total	%
Citrus reticulata Blanco [Rutaceae]	**Mangada**	**38**							1																39	16.4
Psidium guajava L. [Myrtaceae]	**Mapeera**	**17**	1	1					2																21	8.8
Combretum collinum Fresen. [Combretaceae]	**Mukoola-koola/ Nsabagwa**			12	1				2	1	2		1				1								20	8.4
Ficus glumosa Delile [Moraceae]	**Mukoko**		**7**	3	**6**		1							1				1		1					20	8.4
Tamarindus indica L. [Fabaceae]	**Mukooge**	**10**	2	1	1				4																18	7.6
Melia azedarach L. [Meliaceae]	**Lira**		**4**	**4**	1	2				2	1	1					2								17	7.1
Albizia zygia (DC.) J.F. Macbr. [Fabaceae]	**Mulongo/ Nnongo**		4	3	2				2	1	2	1								1					16	6.7
Moringa oleifera Lam. [Moringaceae]	**Moringa**	2			1	1			**11**													1			16	6.7
Syzygium cumini (L.) Skeels [Myrtaceae]	**Muziru**	**10**	4	1	1																				16	6.7
Combretum molle R. Br. ex G. Don [Combretaceae]	**Endawa**			4	2						7														13	5.5
Terminalia glaucescens Planch. ex Benth. [Combretaceae]	**Musasa**			3						1	**8**				1										13	5.5
Terminalia spp. [Combretaceae]	**Umbrella tree**			1	**7**								1		1				1						11	4.6
Senna spectabilis (DC.) H.S. Irwin & Barneby [Fabaceae]	**Kibiliti**			3	1					3	2		1												10	4.2
Vitex ferruginea Schumach. & Thonn. [Lamiaceae]	**Mukelemba**			1					1		1	2	1												6	2.5

Species [Family]	Common name	Edible fruit	Timber	Firewood	Shade	Income	Bark cloth	Fodder	Medicine	Poles	Charcoal	Construction	Wind breaker	Intercropping	Beautify compound	Rain formation	Rubber	Soil fertility	Fencing	Water retention	Bee keeping	Making soap	Mosquito repellant	Demarcating land	Total	%
Acacia seyal Delile [Fabaceae]	**Mufu-wanduzi**			1					4																5	2.1
Canarium schweinfurthii Engl. [Burseraceae]	**Mubafu**	3	1	1																					5	2.1
Lannea schweinfurthii (Engl.) Engl. [Anacardiaceae]	**Musinga-bakali**				4								1												5	2.1
Teclea nobilis Delile [Rutaceae]	**Muzo**			3					1		1														5	2.1
Piliostigma thonningii (Schumach.) Milne-Redh. [Fabaceae]	**Kirama**								2			2													4	1.7
Grevillea spp. [Proteaceae]	**Gulvia**		4																						4	1.7
Annona reticulata L. [Annonaceae]	**Mustaferi**	4																							4	1.7
Acacia hockii De Wild. [Fabaceae]	**Kasoone**			2					1																3	1.3
Acacia polyacantha Willd. [Fabaceae]	**Mukongoito**			1					1		1														3	1.3
Calliandra calothyrsus Meisn. [Fabaceae]	**Kaliandra**							2										1							3	1.3
Carissa edulis (Forssk.) Vahl [Apocynaceae]	**Muyonza**	1		1					1																3	1.3
Ficus spp. [Moraceae]	**Kabalira**			1	1									1											3	1.3
Cupressus lusitanica Mill. [Cupressaceae]	**Christmas tree**		1												1				1						3	1.3
Spathodea campanulata P. Beauv. [Bignoniaceae]	**Kinalisa**			1							1														2	0.8
Theobroma cacao L. [Malvaceae]	**Cocoa**	2																							2	0.8

Species [Family]	Common name	Edible fruit	Timber	Firewood	Shade	Income	Bark cloth	Fodder	Medicine	Poles	Charcoal	Construction	Wind breaker	Intercropping	Beautify compound	Rain formation	Rubber	Soil fertility	Fencing	Water retention	Bee keeping	Making soap	Mosquito repellant	Demarcating land	Total	%
Thevetia peruviana (Pers.) K. Schum. [Apocynaceae]	**Bustani**														2										2	0.8
Vernonia amygdalina Delile [Asteraceae]	**Lubirizi**								2																2	0.8
unidentified	**Mugalagasa**			1							1														2	0.8
unidentified	**Musiwa/ Musiya**		1		1																				2	0.8
Acacia spp. [Fabaceae]	**Muwa**			1																					1	0.4
Allophylus africanus P. Beauv. [Sapindaceae]	**Kasakasaka**			1																					1	0.4
Broussonetia papyrifera (L.) L'Hér. ex Vent. [Moraceae]	**Mukulaido**		1																						1	0.4
Capparis afzelii DC. [Capparidaceae]	**Muzikiiza**		1																						1	0.4
Citrus sp., [Rutaceae]	**Mulimawa**								1																1	0.4
Eugenia jambos L. [Myrtaceae]	**Muzabibu**	1																							1	0.4
Euphorbia candelabrum Tremaut ex Kotschy [Euphorbiaceae]	**Mukukulu**				1																				1	0.4
Euphorbia tirucalli L. [Euphorbiaceae]	**Lukone**																							1	1	0.4
Ficus platyphylla Delile [Moraceae]	**Nkame**				1																				1	0.4
Gardenia ternifolia Schumach. & Thonn. Subsp. *jovis-tonantis* (Welw.) Verdc. [Rubiaceae]	**Kawuna**			1																					1	0.4
Jatropha curcas L. [Euphorbiaceae]	**Kiroowa**																		1						1	0.4

Species [Family]	Common name	Edible fruit	Timber	Firewood	Shade	Income	Bark cloth	Fodder	Medicine	Poles	Charcoal	Construction	Wind breaker	Intercropping	Beautify compound	Rain formation	Rubber	Soil fertility	Fencing	Water retention	Bee keeping	Making soap	Mosquito repellant	Demarcating land	Total	%
Lantana camara L. [Verbenaceae]	**Kapanga**			1																					1	0.4
Maytenus senegalensis (Lam.) Exell [Celastraceae]	**Muwaiswa**								1																1	0.4
Rhus natalensis Bernh. [Anacardiaceae]	**Kakwanso**	1																							1	0.4
Lannea barteri (Oliv.) Engl. [Anacardiaceae]	**Mukon-tambale**										1														1	0.4
Stereospermum kunthianum Cham. [Bignoniaceae]	**Ndebeza/ mule-mangundu/ Enyite**										1														1	0.4
Casuarina spp. [Casuarinaceae]	**Kasalina**				1																				1	0.4
unidentified	**Luwalu**	1																							1	0.4
unidentified	**Rubinzi**								1																1	0.4

Appendix 2. Marketable species or products and clients in Balawoli Sub-county, Kamuli District, Uganda.

Species/product	Middlemen	Fellow farmers	Total	%
Citrus sinensis (L.) Osbeck	44	6	50	19.6
Artocarpus heterophyllus Lam.	28	13	41	16.1
Mangifera indica L.	29	6	35	13.7
Coffea spp.	24	1	25	9.8
Milicia excelsa (Welw.) C.C. Berg	7	9	16	6.3
Citrus reticulata Blanco	11		11	4.3
Maesopsis eminii Engl.	4	6	10	3.9
Persea americana Mill.	7	2	9	3.5
Citrus limon (L.) Osbeck	6	3	9	3.5
Ficus natalensis Hochst.	2	3	5	2.0
Carica papaya L.	2	3	5	2.0
Markhamia lutea (Benth.) K. Schum.	0	4	4	1.6
Eucalyptus spp.	1	2	3	1.2
Terminalia glaucescens Planch. ex Benth.	1	1	2	0.8
Teclea nobilis Delile	2		2	0.8
Albizia coriaria Welw. ex Oliv.		2	2	0.8
Tamarindus indica L.	1		1	0.4
Senna siamea (Lam.) H.S. Irwin & Barneby		1	1	0.4
Moringa oleifera Lam.	1		1	0.4
Ficus sycomorus L.	1		1	0.4
Combretum molle R. Br. ex G. Don	1		1	0.4
Combretum collinum Fresen.	1		1	0.4
Albizia zygia (DC.) J.F. Macbr.	1		1	0.4
Pinus spp.		1	1	0.4
Timber	1	6	7	2.7
Medicine		1	1	0.4
Furniture		1	1	0.4
Firewood		2	2	0.8
Charcoal	1	3	4	1.6

Appendix 3. Woody species reportedly maintained by farmers and their location on farms in Balawoli Sub-county, Kamuli District, Uganda.

Species	Where found					Total
	Garden	Courtyard	Backyard	Hedge	Everywhere	
Maesopsis eminii Engl.	85	20	16	12		133
Mangifera indica L.	64	34	19	4	1	122
Milicia excelsa (Welw.) C.C. Berg	95	14	7			116
Artocarpus heterophyllus Lam.	64	29	17	2		112
Citrus aurantium L.	45	30	23	1	1	100
Ficus natalensis Hochst.	71	10	7	2		90
Albizia coriaria Welw. ex Oliv.	59	6	3			68
Coffea spp.	42	4	8			54
Carica papaya L.	16	13	11			40
Persea americana Mill.	12	6	9			27
Markhamia lutea (Benth.) K. Schum.	22	4	2	2		30
Citrus reticulata Blanco	9	11	1		1	22
Ficus sycomorus L.	20	1	1			22
Senna siamea (Lam.) H.S. Irwin & Barneby	12	7	2	1		22
Citrus limon (L.) Osbeck	10	6	2			18
Pinus spp.	15		1			16
Eucalyptus spp.	9	2		3		14
Ficus glumosa Delile	10		3			13
Melia azedarach L.	8	2	2			12
Tamarindus indica L.	7	2	1	1		11
Lannea schweinfurthii (Engl.) Engl.	4	2	1			7
Moringa oleifera Lam.	3	3	3			9
Albizia zygia (DC.) J.F. Macbr.	6	1				7
Combretum collinum Fresen.	6	1				7
Combretum molle R. Br. ex G. Don	4	2				6
Terminalia glaucescens Planch. ex Benth.	6					6
Psidium guajava L.	7					7
Vitex ferruginea Schumach. & Thonn.	4	1				5
Senna spectabilis (DC.) H.S. Irwin & Barneby	1	1	1			3
Acacia polyacantha Willd.	2		1			3
Grevillea spp.		1	2			3
Syzygium cumini (L.) Skeels	3					3
Terminalia spp.	1	2				3
Thevetia peruviana K.Schum				3		3

Species	Where found					Total
	Garden	Courtyard	Backyard	Hedge	Everywhere	
Gardenia ternifolia Schumach. & Thonn. Subsp. *jovis-tonantis* (Welw.) Verdc.	2					2
Acacia seyal Delile			1			1
Allophylus africanus P. Beauv.	1					1
Anacardium occidentale L.		1				1
Canarium schweinfurthii Engl.	1					1
Ficus sp.	1					1
Ficus vallis-choudae Delile	1					1
Jatropha curcas L.				1		1
Lannea barteri (Oliv.) Engl.	1					1
Manihot glaziovii Müll. Arg.	1					1
Teclea nobilis Delile	1					1
Unidentified, **Mukomakoma**	2		1			3
Unidentified, **Bandiri**		1				1
Unidentified, **Kalongo**				1		1
Unidentified, **Mukokowe**	1					1
Unidentified, **Mukoma mawanga**		1				1
Unidentified, **Sikamoti**		1				1
Total	**734**	**219**	**145**	**33**	**3**	**181**