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Use Patterns of Indigenous Woody Species in and around Agoro-Agu Central Forest Reserve, Northern Uganda

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Abstract

Forests are an essential component of rural livelihoods around the world. This paper assessed the utilization patterns of indigenous woody plant species in and around Agoro-Agu Central Forest Reserve in northern Uganda. Data were collected using a combination of semi-structured household interviews, Focus Group Discussions and key informant interviews. A total of 108 households participated in the interviews. Statistical tests were performed using the SPSS software package (SPSS Version 16, SPSS Inc. USA). Chi-square (X2) tests were run to determine the association between socio-economic characteristics of the respondents and woody plant species use patterns. The study recorded 86 useful species in 60 genera and 28 families. *Mimosaceae* was the most dominant family. The main use categories were fuel (36%), construction (29.8%), food (15.6%), and household implements (11.3%). Commonly harvested woody plant parts were stems (66.8%) and fruits (14.5%). Ecological knowledge varied significantly (p=<0.05) with the age and village of residence of the respondents. The study has shown that the people of Agoro-Agu utilize a wide range of woody plant species to meet their subsistence needs. The inhabitants are the store house of traditional knowledge on important woody plant species. However, the extraction of these woody species by the local communities, if not sustainably managed, is likely to put pressure on the forest resources of Agoro-Agu landscape. The paper recommends that the National Forestry Authority and partners need to regularly monitor the populations of these useful woody plant species, while creating awareness on sustainable utilization among the local communities.

Keywords: Ethnobotany; Farmlands; Protected area; Rural livelihoods; Traditional knowledge

Introduction

Forests are an essential component of rural livelihoods [1]. Globally, it is estimated that between 1.095 billion and 1.745 billion people depend to varying degrees on forests for their livelihoods and about 200 million indigenous communities are almost fully dependent on forests [2].

CIFOR [3] estimates that over two-thirds of Africa's population rely directly or indirectly on forests for their livelihoods.

Forests provide wood-based goods (e.g. firewood, building poles, timber), non-timber goods (e.g. food, medicines), and services (e.g., water conservation, soil moisture retention, flood abatement, contribution to soil fertility, carbon storage and maintenance of biodiversity) [4].

Beyond their regular use, forest products can provide rural households with a safety net when other sources of income fail [5].

In Uganda, forestry is crucial to the lives of millions of the population especially the poorest sections of society [6].

Benefits of forests to Ugandans especially the poor has mainly focused on the numerous direct benefits in form of food, energy, employment, and incomes.

Like many Protected Areas, Agoro-Agu Central Forest Reserve faces many challenges including growth in human population and corresponding increase in demand for various forest products, expansion of agricultural land, and degradation.

The pressure on the Forest Reserve is compounded by the existence of 'enclaves' or settlements within the reserve, which have inhabitants who exploit it for a variety of products.

This paper examines the local-level utilization of indigenous woody plants by rural households in and around Agoro-Agu Central Forest Reserve in northern Uganda.

Materials and Methods

Study area

The study was conducted in the three villages of Lomwaka; Larach Odong; and Polocire, in and around Agoro-Agu Central Forest Reserve (CFR).

The Forest Reserve is located in Lamwo District in northern Uganda, at coordinates: 03° 40'- 03°53′ N and 32°42′- 33° 04′ E, and an altitude ranging between 110-2700 m above sea level [7], as indicated in Figure 1.

Agoro-Agu CFR was gazetted in 1937 as a natural forest for biodiversity conservation, covering 26,508 hectares [8].

The Reserve is covered by a forest/savanna mosaic at high altitudes. Common vegetation types are *Combretum-Acacia-Themeda savanna, Juniperus-Podocarpus*, dry montane forest, *Cyperus-papyrus swamp*,

Acacia-Cymbopogon-Themeda complex; and *Butyrospermum-Hyparrhenia dissoluta savanna*.

Rainfall is bimodal in Lamwo District. Rain starts in late March or early April and ends in November, with peaks in April and August, ranging from 800-1000 mm.

The rainfall patterns seems is changing, with rainfall onset sometimes starting as late as beyond traditionally known March - probably due to the changing climatic conditions.

It is usually dry-hot and windy from December to mid March. Temperature ranges between 20°C and 30°C. Gray-brown sands overlying red clay or brown sandy loam soils characterize the area.

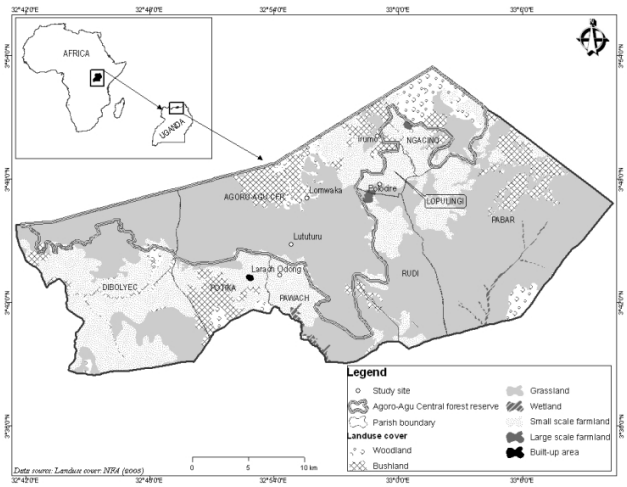

Figure 1: Map of Agoro-Agu showing the study sites.

Data Collection

Data collection methods used in the study comprised a social survey as described by Martin [9] Field data were collected using a combination of semi-structured household interviews, Focus Group Discussions (FGDs) with local communities, and key informant interviews.

A total of 108 households participated in the interviews.

The number of woody species that a given household head could list during the questionnaire survey was considered as the ecological knowledge within and among the age and gender groups of the study participants.

Plants mentioned in the interviews were collected and voucher specimens are deposited at the Makerere University Herbarium.

Data Analysis

Statistical tests performed using the SPSS software package (SPSS Version 16, SPSS Inc. USA).

Descriptive statistics were used to obtain frequency and utilization patterns graphs. The Chi-square (X^2) test was run to determine the association between socio-economic characteristics of the respondents and woody species utilization patterns.

Results

Characteristics of respondents

Overall, more (64%) female respondents participated in this study compared to the male respondents (36%) (Figure 2a).

The average age and number of people per household were 39 years and six people, respectively (Figures 2c and 2d). The main economic activity of the respondents was crop farming.

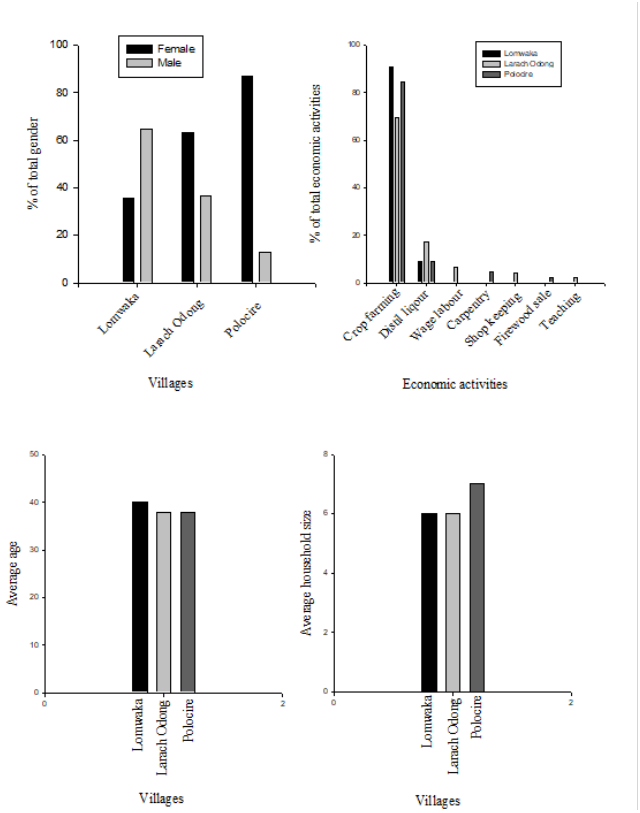

Figure 2: Proportion of respondents' characteristics of the three study villages (N=108): (a) gender of respondents; (b) main economic activities; (c) average age of respondents; and (d) average household size (persons).

Woody plant species utilized by local communities

Overall, 86 useful species in 60 genera and 28 families were listed by the local people (Table 1). Mimosaceae was the most species-rich family (13%).

The most utilized woody species by the communities living in and around the forest were *Terminalia brownii Fresen* (11.3%), *Acacia hockii* De Wild. (6.3%) and *Combretum molle* G. Don. (5.8%).

		Frequency			
Species	**Family**	**FR**	**FL**	**Both**	**Overall frequency**
Terminalia brownii Fresen	Combretaceae	55	37	11	103
Acacia hockii De Willd.	Mimosaceae	50	29	19	98
Combretum molle G.Don.	Combretaceae	45	29	17	91
Grewia mollis Juss.	Tiliaceae	35	33	17	85
Ziziphus abyssinica Hochst.ex A.Rich.	Rhamnaceae	54	16	15	85
Balanites aegyptiaca (L.) Del.	Balanitaceae	51	18	15	84
Grewia trichocarpa Hochst.ex A.Rich.	Tiliaceae	57	1	8	66
Carissa edulis (Forssk.) Vahl	Apocynaceae	41	3	11	55
Dalbergia melanoxylon Guill. and Perr.	Fabaceae	43	5	7	55
Acacia mearnsii De Wild.	Mimosaceae	39		10	49
Bridelia micrantha (Hochst.) Baill.	Euphorbiaceae	24	8	4	36
Vitellaria paradoxa Gaertn.	Sapotaceae	11	16	9	36
Terminalia glaucescens Benth.	Combretaceae	12	16	7	35
Dicrostachys cinerea (L.) Wight. and Arn.	Mimosaceae	25	3	5	33
Tamarindus indica L.	Caesalpiniaceae	17	9	6	32
Lannea fulva Engl.	Anacardiaceae	14	5	11	30
Ficus sur Forssk.	Moraceae	18	5	5	28
Piliostigma thonningii Milne-Redh.	Caesalpiniaceae	11	10	7	28
Sclerocarya birrea (A.Rich.) Hochst.	Anacardiaceae	15	5	4	24
Ficus sycomorus Linn.	Moraceae	13	7	3	23
Acacia sieberiana DC.	Mimosaceae	15	5	1	21
Vitex doniana Sweet	Verbenaceae	10	7	3	20
Ficus natalensis Hochst.	Moraceae	12	6	1	19
Lovoa swynnertonii Bak.f.	Meliaceae	9	4	3	16
Drypetes gerrardii Hutch.	Euphorbiaceae	11	2	1	14
Strychnos spinosa Lam	Loganiaceae	12		2	14
Warburgia salutaris (Bertol.f.) Chiov.	Canellaceae	13	1		14
Faurea saligna Harv.	Proteaceae	10	2	1	13
Lonchocarpus laxiflorus Guill. and Perr.	Fabaceae	5	4	2	11
Ozoroa insignis Del.	Anacardiaceae	9		2	11

Table 1a: Woody species used by communities in and around the forest arranged in descending rank of frequency. Values refer to the number of times each species was mentioned. FR: Forest Reserve; FL: Farmland; Both: FR+FL; Overall frequency=FR+FL+Both.

Table 1 (continued)

		Frequency			
Species	**Family**	**FR**	**FL**	**Both**	**Overall frequency**
Chaetachme aristata Planch.	Ulmaceae	10			10
Dombeya burgessiae Harv.	Sterculiaceae	9		1	10
Dombeya claessensii De Wild.	Sterculiaceae	6	3	1	10
Maytenus senegalensis (Lam.) Excell.	Celastraceae	2	3	5	10
Mussaenda sp.	Rubiaceae	6	1	3	10
Lannea sp.	Anacardiaceae	5	3	1	9
Podocarpus latifolius (Thunb.) R.Br. Ex Mirb.	Podocarpaceae	9			9
Senna spectabilis (DC.) HS Irwin and Barneby	Caesalpiniaceae	1	6	2	9
Baikiaea insignis Benth.	Caesalpiniaceae	7		1	8
Cola gigantea A.Chev.	Sterculiaceae	8			8
Pleurostylia capensis Loes.	Celastraceae	6	1	1	8
Stereospermum kunthianum Cham.	Bignoniaceae	5		3	8
Unidet 2		6	1	1	8
Acacia polyacantha Willd.	Mimosaceae	3	1	3	7
Acacia senegal (L.) Willd.	Mimosaceae	5	1	1	7
Bridelia ndellensis Beille	Euphorbiaceae	4	2	1	7
Ficus platyphylla Del.	Moraceae	2	1	4	7
Pseudocedrela kotschyi (Schweinf.) Harms	Anacardiaceae	1	5	1	7
Zanthoxylum leprieurii (Guill. et Perr.) Engl.	Rutaceae	6		1	7
Acacia seyal Del.	Mimosaceae	3	1	1	5
Bridelia scleronuera Pax.	Euphorbiaceae	4		1	5
Commiphora sp.	Burseraceae	5			5
Erythrococca bongensis Pax.	Euphorbiaceae	4		1	5
Prosopis pallida H.B.K	Mimosaceae	3	1	1	5
Protea madiensis Oliv.	Proteaceae	4		1	5
Albizia coriaria Welw.ex Oliv.	Mimosaceae	2		2	4
Annona senegalensis Pers.	Annonaceae	3	1		4
Ficus glumosa Del.	Moraceae	3		1	4
Pseudospondias microcarpa (A.Rich.) Engl.	Anacardiaceae	2	1	1	4
Commiphora africana (Arn.) Engl.	Burseraceae	1		2	3
Gardenia imperialis K.Schum.	Rubiaceae	1	2		3
Ormocarpum trichocarpum (Taub.) Harms.	Fabaceae		2	1	3
Tarenna graveolens Bremek.	Rubiaceae	3			3

Table 1b: Woody species used by communities in and around the forest arranged in descending rank of frequency. Values refer to the number of times each species was mentioned. FR: Forest Reserve; FL: Farmland; Both: FR+FL; Overall frequency=FR+FL+Both.

Table 1 (continued)

		Frequency			
Species	**Family**	**FR**	**FL**	**Both**	**Overall frequency**
Trichilia emitica Vahl	Meliaceae	3			3
Albizia grandibracteata Taub.	Mimosaceae			2	2
Antiaris toxicaria (Rumph.ex Pers.) Lesch.	Moraceae	1		1	2
Euphorbia candelabrum Kotschy	Euphorbiaceae	1		1	2
Ficus barteri Sprague	Moraceae	1		1	2
Kigelia africana (Lam.) Benth.	Bignoniaceae		1	1	2
Lovoa trichilioides Harms	Meliaceae		2		2
Acacia macrothyrsa Harms.	Mimosaceae			1	1
Antidesma laciniatum Muell.	Euphorbiaceae	1			1
Boscia salicifolia Oliv.	Capparaceae	1			1
Erythrina excelsa Bak.	Fabaceae		1		1
Lannea schimperi (A.Rich.) Engl.	Anacardiaceae	1			1
Maerua angolensis DC.	Capparaceae	1			1
Markhamia lutea (Benth.) Schum.	Bignoniaceae	1			1
Mimusops bagshwei S.Moore	Sapotaceae	1			1
Nauclea diderrichii (De Wild.) Merr.	Rubiaceae	1			1
Ochna holstii Engl.	Ochnaceae	1			1
Rothmannia urcelliformis (Hiern.) Robyns	Rubiaceae	1			1
Sarcocephalus latifolius (Smith.) Bruce	Rubiaceae			1	1
Securidaca longipedunculata Fres.	Polygalaceae	1			1

Table 1c: Woody species used by communities in and around the forest arranged in descending rank of frequency. Values refer to the number of times each species was mentioned. FR: Forest Reserve; FL: Farmland; Both: FR+FL; Overall frequency=FR+FL+Both.

Utilization patterns of important woody species

Of the useful woody plant species, most (36%) were utilized for fuel, followed by construction (29.8%), food (15.6%), and household implements (11.3%), as indicated in Figure 3b. Few (0.1%) species (e.g. *Lonchocarpus laxiflorus Guill. and Perr. and Ficus spp.*) were utilized for cultural purposes. The preferred fuelwood species were *T. brownii, A.hockii, C.molle, Balanites aegyptiaca (L.) Del.,* and *Grewia mollis Juss.* The species mostly utilized for construction were *Terminalia glaucescens Benth., Dalbergia melanoxylon Guill. and Perr., G.mollis, Grewia trichocarpa Hochst.ex A.Rich., Dombeya burgessiae Harv., Ziziphus abyssinica Hochst.ex A.Rich., T. brownii, A.hockii,* and *C.molle*. The preferred species for food were *B. aegyptiaca, Tamarindus indica L., Vitex doniana* Sweet, *Vitellaria paradoxa Gaertn.* and *Carissa edulis (Forssk.) Vahl*. The commonly reported household implements were wooden handles for knife, hoe, and axe; mingling stick; 3-pronged stirrers; toothbrush; mortar and pestle. The preferred woody species for the household implements were *Acacia mearnsii* De Wild., *G.trichocarpa, Lannea fulva Engl.*, and *T. brownii*. The common diseases reported in Agoro-Agu were diarrhea, fire burns, cough, sprains, chest pains, syphilis, and itchy skin. The preferred medicinal species were *Sarcocephalus latifolius (Smith.) Bruce, Piliostigma thonningii Milne-Redh., Kigelia africana (Lam.) Benth., Warburgia salutaris (Bertol.f.) Chiov.,* and *T. brownii.*

Commonly harvested woody plant parts were stems (66.8%) and edible fruits (14.5%) (Figure 3c). Most (61%) woody species were extracted from the Forest Reserve (Figure 3a). The woody plant species had multiple uses, and were extracted mostly (57.2%) within a distance of between 1-5 km from the respondents' homestead. Two species, *Balanites aegyptiaca (L.) Del.* and *Vangueriopsis longiflora Verdc.* were extracted from relatively distant places of over 5 km by the respondents in Lomwaka village. The Chi-square (X^2) analysis of the results showed that there were significant ($p<0.05$) relationships between species location (the villages) and gender (females and males); and age group (except between the village Larach Odong and respondents' age group of<31 and>50 years). There was no significant difference ($p>0.05$) between the parts consumed (stems, branches, leaves, fruits, stem-

bark, twigs, and roots) and the distance travelled to harvest the species (except between distance of>5 km and fruits; and 3-5 km and branches). There was no significant ($p>0.05$) difference between the villages and the occupation of the respondents.

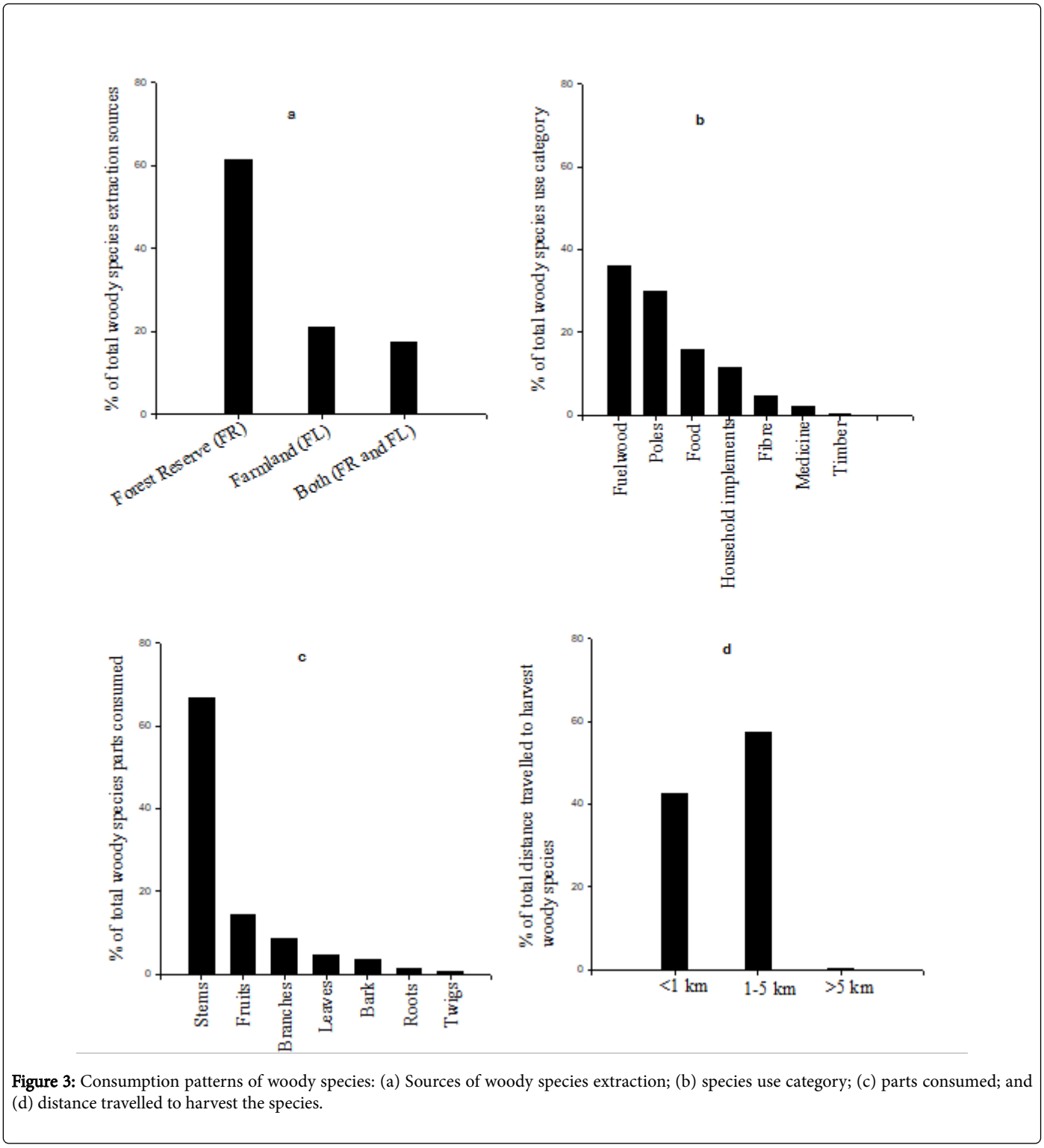

Figure 3: Consumption patterns of woody species: (a) Sources of woody species extraction; (b) species use category; (c) parts consumed; and (d) distance travelled to harvest the species.

Household ecological knowledge

The age group of<31 years listed more (44%) woody species compared to age group 31-50 years (31%) and those respondents over 50 years (25%). Females had higher (64%) ecological knowledge than the males (36%). Residents of Larach Odong village listed the highest (43%) number of woody species, followed by those of *Polocire* (37%), and *Lomwaka* (20%). The Chi-square (X^2) test indicated that ecological knowledge, age groups, and village of residence varied significantly as indicated by the p values in Table 2.

		Gender		Age group			
	Village	**Male**	**Female**	**<31**	**31-50**	**>50**	**Ecological knowledge(Number of woody species listed)**
Chi-Square	45.345	35.634	35.634	6.478	70.152	114.263	165.563
df	2	1	1	1	1	1	2
Asymp. Sig.	0	0	0	0.011	0	0	0

Table 2: The relationship among village, gender, and age as explanatory variables on ecological knowledge of respondents.

Discussion

This study recorded a total of 86 woody plant species commonly utilized by the local people in and around Agoro-Agu CFR. The species were multipurpose in nature, and were mostly (36%) utilized for fuel wood, and construction (30%). These species were mainly (61%) extracted from the forest reserve, and in the adjacent farmlands (21%). A study by Marpa, et al.,[10] on indigenous uses of plants in the north western Himalaya in India, indicated that the plants were mainly utilized for medicine, fodder, food, fuel, religious, timber, making agricultural tools, and dyes. Hudson, et al.,[11], recorded 118 plant species utilized by local communities for various purposes in the Chimanimani Trans-Frontier Conservation Area in Mozambique. The exploitation of a high diversity of plant species for subsistence is typical of rural communities of developing countries [12]. Utilization of the woody plants by the people of Agoro-Agu demonstrates the close relationship that these people have with plants and also points to a rich reservoir of traditional knowledge within the community. Turner, et al. [13] showed that traditional ecological knowledge of indigenous people has fundamental importance in the management of local resources, and in the husbandry of the world's biodiversity. In Agoro-Agu, there are a number of woody plant species (e.g. *Ficus spp.*) that are regarded as sacred in the sense that no felling or exploitation was carried out. They were mainly utilized for cultural rituals. This indicates that these culturally important woody species are probably better conserved in this landscape. Some utilized woody species in the study area such as *Vangueriopsis longiflora* were extracted from relatively longer distances. Similar trends have been reported for *Hibiscus spp.* in Mabira forest in central Uganda where the local people traveled longer distances in search of woody plant species to harvest [14]. Long distances travelled by the communities to access such species may be an indicator that they have been depleted from areas near the community. There is therefore a need to prioritize such species in conservation efforts.

Commonly harvested woody plant parts were stems (66.8%) and edible fruits (14.5%). A study by Marpa et al. [10], on indigenous uses of plants in North Western Himalaya in India showed that the most utilized plant parts were, in descending order of importance, leaf, whole plant, root and fruit. Depending on the plant parts harvested, the utilization of the woody species may be destructive or non-destructive in nature [15]. For example, in the present study, *Lonchocarpus laxiflorus* is utilized mainly for cultural practices, which does not involve cutting of the tree, whereas species like *C.molle, T.brownii*, and *A.hockii* were mainly utilized for firewood and building poles, which are destructive in nature due to cutting down of the species. Wood extraction by local communities for the various purposes if not properly managed, is likely to put pressure on the forest resources of Agoro-Agu and the surrounding areas. The pressure on the forest is compounded by the existence of 'enclaves' or human settlements within the reserve, who exploit it for a variety of products. This suggests that the woody plant species with destructive extraction could be threatened with local extinction if not monitored. Therefore, there is a need to develop mechanisms (e.g. equitable sustainable harvesting) so that their regeneration is improved and maintained.

In the present study, the age group<31 years listed more (44%) woody species compared to those who belonged to the age group 31-50 years (31%) and those of over 50 years (25%). Dovie, et al. [16], recorded higher knowledge of plant resource use for both the age group<31 and>50 years. This is in agreement with Luoga et al. [15], who reported higher knowledge of plant resource use among people greater than 35 years. Sop, et al.[17] on the other hand, reported that older people (age>50 years) had a greater knowledge of plant species than younger people (25-50 years), with women and men sharing equally the plant use knowledge (gender did not influence plant utilization). The differences in ecological knowledge is often attributed to the role of age and gender groups in society, which translates mostly into division of labour at the household level and at the community level [16]. Rijal [18], attributed the difference in ecological knowledge between two adjacent age classes to a lack of knowledge transmission. It is therefore important to document and develop strategies of the knowledge transmission to the next generations as a contribution to sustained livelihoods of rural communities. This paper revealed that females had higher ecological knowledge than the males. This is similar to the findings by Rijal [18] who attributed it to the fact that most women in rural societies worldwide are often primarily responsible for ensuring household food security and health. Women are therefore more likely to be interested in the utilization aspects such as food, medicinal purposes, firewood and household implements. On the other hand, men tend to focus on income-generating activities [19]. According to Mathez-Stiefel and Vandebroek [20], gender directly influences the way people interact and use plants. Gender-specific utilization and knowledge of the woody plants may be linked to the life form, taxa, and parts used [21,22]. These results, however, differed with other studies, which reported that gender did not influence plant utilization.

Conclusion and Recommendations

This paper has recorded 86 useful woody plant species in 60 genera and 28 families.

The study has shown that the people of Agoro-Agu utilize a wide range of woody plant species to meet their subsistence needs. The inhabitants are the store house of traditional knowledge on important woody plant species. However, the extraction of these woody species by the local communities, if not sustainably managed, is likely to put

pressure on the forest resources of Agoro-Agu landscape. The paper recommends that the National Forestry Authority and partners need to regularly monitor the populations of these useful woody plant species, while creating awareness on sustainable utilization among the local communities.

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