Diversity of indigenous fruit trees in the traditional cotton-millet farming system: the case of Adwari subcounty, Lira district, Uganda

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Abstract

A field survey on indigenous fruit tree species (IFTS) was conducted in Adwari subcounty, Lira district between August 2004 and March 2005. The objectives were to: determine IFTS diversity in the traditional farming system; generate a species priority list, characterize and document the values of IFTS as perceived by farmers; and develop criteria for selecting IFTS for on-farm cultivation. A questionnaire designed to capture socio-economic data was administered to 120 randomly selected respondents. Farm walks were conducted to identify and assess the proportion of farmland under IFTS. Preference ranking was used to generate a species priority list. On-farm diversity of IFTS was analyzed using Shannon–Wiener's diversity index (H′). DAFOR scale was used to rate occurrence of IFTS on-farm. The diversity of IFTS was relatively high (H′ = 2.164) although the average proportion of farmland under IFTS cover was low (23.3 ± 5%). *Vitellaria paradoxa*, *Vitex doniana*, *Anona senegalensis* and *Tamarindus indica* were most preferred by local people. The choice of IFTS for on-farm cultivation varied from their food, medicinal to cash values. There is a need to formulate clear policies and by-laws to encourage on-farm cultivation of IFTS.

Key words: agroforestry, edible fruits, gardens, species diversity

Introduction

Rural poverty and malnutrition are often linked to poor farming, low agricultural production and limited off-farm incomes (Shah & Strong, 1999). According to the World Bank (1996), the growth rate in food production in Africa south of the sahara should increase annually by 4% to achieve food security compared with the actual average of <2% over the last 30 years. Alternative sources of nutrition and income need to be introduced to supplement the agricultural crops that are currently grown. Today, with a new understanding of their values, indigenous fruit trees are increasingly becoming important in the farming systems of many small-scale farmers (Chin, 1985; Roshetko & Evans, 1997). Apart from their value in assuring food and nutritional security, the income potential from indigenous fruit trees is enormous in the impoverished economy (Maghembe *et al.*, 1998). By selling condiments from these trees, farmers' annual incomes may be doubled (Sanchez, 2001).

In Uganda, however, on-farm cultivation of indigenous fruit trees forms a very small component of farming practices. Yet the country's Plan for Modernisation of Agriculture (PMA) emphasizes the need to integrate fruit trees in the traditional farming systems to improve agricultural production from subsistence into market oriented production (Ministry of Agriculture, Animal Industry & Fisheries, 2000a,b). The PMA and the accompanying improvement in agricultural service delivery through the National Agricultural Advisory Services (NAADS), therefore, offer prospects for scaling up on-farm indigenous fruit tree cultivation and making them prominent in the farming practices. This study aimed at (i) determining the indigenous fruit tree species (IFTS) diversity in the traditional farming system; (ii) generating a species priority list, indicating the values of IFTS as perceived by farmers; and (iii) developing criteria for selecting IFTS for on-farm cultivation. The study sought answers to the following questions: Which indigenous IFTS are preferred and valued by farmers and why? What are the features of IFTS that can aid their selection for on-farm cultivation?

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Materials and methods

The study was conducted in Adwari subcounty, Otuke county in Lira district in the northern part of Uganda. Adwari is located between 2°25′–2°47′N and 33°02′–38°38′E (LDSOER, 1997). The largest part of the subcounty has acidic and deeply weathered soils with low cation exchange capacity (LDSOER, 1997). The average minimum and maximum temperatures are 22.5 and 25.5°C respectively. The average annual rainfall is 1200 mm. The subcounty is covered with wooded savanna. Large areas of original tree-savanna occupied areas have been taken over by farming and grazing (Planning Unit Lira, 2004). About 82% of the total population and 79% of the households derive their livelihood from farming.

Semi-structured questionnaires were administered to a total of 120 randomly selected respondents. The purpose was to capture socio-economic data and information on IFTS. The area was stratified into seven administration units (parishes) and respondents from each unit were selected systematically for the interview. The number of respondents selected from each unit ranged from 15 to 17, which was relative to the size of its population. On-farm walks were conducted in Omito parish. Thirty farms (each estimated to be about 1 hectare) were randomly sampled and surveyed. The aim of the farm walk was to observe and record IFTS on the farms and assess visually the proportion of farmland under IFTS cultivation. Preference ranking was used to generate a species priority list of IFTS preferred by the local people. Each respondent was asked to indicate fifteen species in order of preference. The highest priority species out of fifteen was assigned fifteen points, fourteen points to the second highest and the lowest ranked species assigned one point. The points for each species were summed across all respondents. The species were then prioritized according to the total points scored.

Statistical Package for Social Sciences (SPSS) software program (Norusis, 2004) was used to analyse the questionnaire responses. Shannon–Wiener's diversity index (HE) was used to analyse on-farm diversity of IFTS. The higher the value of the index, the more diverse the farms are in terms of IFTS and vice versa. The values of the index usually lie between 1.5 and 3.5, although in exceptional cases, they can exceed 4.5 (Kent & Coker, 1994). The index has the form:

$$H' = -\sum_{i=1}^{s} p_i \ln p_i,$$

where H' = Shannon–Wiener's diversity index; S = the number of species; p_i = the proportion of individuals or the abundance of the i^{th} species expressed as a proportion of total number of individuals; ln = log base$_n$.

DAFOR – an acronym for Dominant, Abundant, Frequent, Occasional and Rare (Forest Department, 2004) was used to rate the occurrence of IFTS on-farm. DAFOR scale was used because it is suitable for data generated by rapid assessment of plant species. The following criteria were used to rate the occurrence of the species in the study: rare (1–20), occasional (21–40), frequent (41–60), abundant (60–80) and dominant (>80) where the numbers refer to the observed number of individuals of a particular species.

Results and discussion

Diversity of IFTS on farms

In all, sixteen IFTS was recorded in the 30 farms surveyed. Their diversity on-farm (Table 1) was relatively high (H′ = 2.164). Other than shear butter trees (*Vitalleria pa-*

Table 1 Diversity of indigenous fruit tree species on farms

Species	No. individuals	Rank	p_i	ln p_i	p_i ln p_i
Vitalleria paradoxa C.F. Gaertn.	176	1	0.305	−1.187	−0.362
Anona senegalensis Pers.	101	2	0.175	−1.743	−0.305
Vitex doniana Sweet.	82	3	0.142	−1.951	−0.277
Grewia mollis Juss.	40	4	0.069	−2.669	−0.185
Tamarindus indica L.	35	5	0.061	−2.802	−0.170
Carissa edulis Vahl.	33	6	0.057	−2.861	−0.164
Borassus aethiopium Mart.	27	7	0.047	−3.062	−0.143
Bridelia scleroneura Müll. Arg.	22	8	0.038	−3.267	−0.125
Ximenia Americana L.	17	9	0.029	−3.525	−0.104
Vangueria apiculata K. Schum.	11	10	0.019	−3.960	−0.075
Diospyros mespiliformis Hochst. ex A.DC.	11	11	0.019	−3.960	−0.075
Strychnos spinosa Lam.	9	12	0.016	−4.161	−0.065
Vangueria infausta Burch.	6	13	0.010	−4.566	−0.047
Ficus natalensis Hochst.	3	14	0.005	−5.259	−0.027
Ficus sur Forssk.	3	14	0.005	−5.259	−0.027
Lantana camara L.	1	16	0.002	−6.358	−0.011
Total	577	$H' = -\Sigma p_i \ln p_i = 2.164$			

radoxa), the IFTS were not deliberately planted. They grew on their own on the farms and were not looked after. Due to prolonged drought, continuous cultivation, fuelwood and charcoal burning, most of the IFTS are threatened to disappear. Fruits from these trees although nutritious, are not very popular with the younger generations. Their consumption by the young people is associated with poverty and primitivism. There was therefore a tendency towards the exotic fruits. This tendency to disregard IFTS has also been reported in other countries (Gumbo *et al.*, 1990; Chweya, 1997).

Frequency distribution analysis indicated that three of the IFTS – *Vitalleria paradoxa* with176 trees (30.5%), *Anona senegalensis* (17.5%) and *Vitex doniana* (14.2%) occurred at a high density on farms (Table 2). However, species occurrence rating using DAFOR scale showed that 50% and 31% of IFTS on-farm were rare and occasional respectively. No single species was found to be frequent and abundant on the farmland.

The average proportion of farmland under IFTS cover was low (23.3 ± 5%) as shown in Table 2. There were only six farms with IFTS cover ≥40% of the total farmland area. The low proportion of farmland under tree cover implies that a lot has to be performed if framers are to meaningfully integrate indigenous fruit trees in their farming systems.

Table 2 Proportion of farmland under indigenous fruit tree species cover

Farm no.	Area under tree cover (%) SE ± 5	Farm no.	Area under tree cover (%) SE ± 5
1	30	15	10
2	15	16	45
3	25	17	20
4	10	18	15
5	15	19	15
6	40	20	30
7	20	21	10
8	20	22	15
9	10	23	30
10	25	24	40
12	30	25	20
13	50	26	15
14	15	27	40
15	10	28	50
16	45	29	30
17	20	30	10
Average farmland under tree cover = 23.3 (±5)			

The high percentage of rare and occasional IFTS on-farm raises concern about the status of the species over time as clearing for agriculture, fuelwood and charcoal production continues. However, as noted by Sheail, Treweek & Mountford (1997), leaving nature alone defeats the purpose of nature conservation. Therefore, there is a need to advocate for the management of indigenous fruit trees on-farm. Although these fruit trees may not have high commercial value now, their existence is of high nutritional and conservation importance.

Preference and values of IFTS to local people

A wide range of indigenous trees were identified as sources of edible fruits. The most preferred species was *Vitalleria paradoxa* followed by *Vitex doniana*, *Anona senegalensis* and *Tamarindus indica* (Table 3). This preference reflects farmers' tastes and may have been influenced by social factors such as ease of access to these indigenous fruits.

According to Okafor (1988) indigenous fruits contribute significantly to diets of rural households as they have high nutritional value and are rich in vitamins and minerals. In this study, all respondents said their families depend on indigenous fruit trees during times of food shortage and that indigenous fruit trees are a good source of income (Table 4). Asked whether indigenous fruit trees have medicinal values, the majority (85%) agreed. For instance one respondent said she uses the root, bark and the leaves of *Vitex doniana,* locally known as Owelo, to treat

Table 3 List of farmers' priority indigenous fruit tree species (in order of importance)

Indigenous fruit trees	Local name	Weight	Rank
Vitalleria paradoxa C.F. Gaertn.	Yao	754	1
Vitex doniana Sweet.	Owelo	517	2
Anona senegalensis Pers.	Obwolo	463	3
Tamarindus indica L.	Chwao	418	4
Bridelia scleroneura Müll. Arg.	Orweco	361	5
Vangueria apiculata K. Schum.	Amalera	288	6
Ximenia americana L.	Olimu	275	7
Carissa edulis Vahl.	Achuga	239	8
Diospyros mespiliformis Hochst. ex A.DC.	Chumu	214	9
Borassus aethiopium Mart.	Tugu	201	10
Ficus sur Forssk.	Ebuu/Oduru	178	11
Strychnos spinosa Lam.	Akwalakwala	155	12
Ficus sycomorus L.	Olam	113	13
Lantana camara L.	Cholawinyo	86	14
Phoenix reclinata Jacq.	Otit	52	15

Table 4 Farmers' perception on the values of indigenous fruit tree species (n = 120)

Variable	%
Families depend on indigenous fruits trees at time of food shortage	
Agree	100
Indigenous fruit trees is a good source of income	
Agree	100
Indigenous fruit trees has a medicinal value	
Agree	85
Do not know	15
Indigenous fruit trees can be intercropped with agric. crops to provide fuelwood from the branches	
Agree	57
Disagree	21
Do not know	23
Indigenous fruit trees has amenity & ornamental values	
Agree	81
Disagree	9
Do not know	10

convulsions, abdominal pain and diarrhoea. The majority (57%) reported that indigenous fruit trees could be intercropped with agricultural crops to provide fuelwood from the pruned branches while 81% believe some indigenous fruit trees like *Phoenix reclinata* and *Tamarindus indica* have amenity and ornamental values.

Criteria for identifying suitable IFTS for on-farm cultivation

The most important criteria used in selecting fruit trees for on-farm cultivation was the contribution made to household food supply. More than 60% of the farmers mentioned provision of food as their main selection criteria. Cash value was also important, as indicated by 58% of the respondents. Other criteria included medicinal value, growth habit (does not shade the agricultural crops), length of the fruiting period, ease of management and drought resistance (Table 5). This is consistent with Minae *et al.* (1994) who reported that farmers in Central Malawi use a combination of factors such as potential for marketing, food value, taste, and the possibility of preserving the fruits while selecting a priority fruit trees for cultivation.

A significant lesson that can be learned from this study is that the proportion of farmlands under IFTS could easily be increased as diversity of these trees on-farmlands in this area is relatively high. There is, however, a need to formulate clear policies and by-laws to guide and promote their cultivation on-farms. In addition, there is also a need to initiate education campaigns among farmers on the food and income potential of IFTS, germplasm conservation and propagation techniques.

Table 5 Criteria used to identify indigenous fruit tree species for on-farm cultivation (n = 120)

Criteria	%
Food value (domestic consumption)	66
Cash value	58
Medicinal value	28
Growth habit (does not shade crops)	27
Ease of management	6
Drought resistance	4
Length of the fruiting period	2

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