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Research Application Summary

Diversity and utilization of selected edible indigenous fruit trees in Northern Uganda

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Abstract

Tropical fruit trees constitute important biological resources in the global agro-biodiversity context. Unlike the tropical fruit trees of American and Asian origin, indigenous fruit trees (IFTs) of tropical Africa have scarcely achieved the status of international recognition in commodity markets and research arena. This study was undertaken in a sub-humid area of northern Uganda to document the diversity of edible IFTs and evaluate domestic consumption and market potential of the selected IFTs. Semi-structured questionnaires, interviews, focused group discussions (FDGs) and transect walks were done to document diversity of IFTs and their utilization in the study area. A total of 302 respondents were interviewed. Results showed that there are 34 edible indigenous fruit trees in the study area. *Vitellaria paradoxa* C.F.Gaetn, *Phoenix reclinata* Jacq, *Ximenia Americana* L, *Vitex doniana* sweet, and *Tamarindus indica* L. were the priority ranked fruit trees. Meanwhile *Vangueria apiculata* K. schum, *Ximenia americana* L, and *Saba comorensis* (Boj.) Pichon were perceived as the most threatened species. Results of the Rapid market surveys (RMS) showed that *Vitellaria paradoxa* C.F.Gaetn is the most understood, highly protected and valued IFT. Others of importance include: *Tamarindus indica* L, *Carissa edulis* Vahl, *Ximenia Americana* L, *Vitex doniana* sweet, *Saba comorensis* (Boj.) Pichon and *Vangueria apiculata* K. schum. These results reveal the need to undertake more studies on unlocking the potentials of IFTs such as *Tamarindus indica* L, *Carissa edulis* Vahl, *Ximenia Americana* L, *Vitex doniana* sweet, *Saba comorensis* (Boj.) Pichon and *Vangueria apiculata* K. schum that are highly preferred because of their market potential.

Key words: Agro biodiversity, focus group discussions, market potential of edible indigenous fruit trees, utilization

Résumé

Les arbres fruitiers tropicaux constituent des ressources biologiques importantes dans le contexte mondial de l'agro-biodiversité. Contrairement aux arbres fruitiers tropicaux d'origine américaine et asiatique, les arbres fruitiers indigènes (IFT) d'Afrique tropicale n'ont guère obtenu le statut de reconnaissance internationale sur les marchés des produits de base et de la recherche. Cette étude a été entreprise dans une zone sous-humide du nord de l'Ouganda en vue de documenter la diversité des IFT comestibles et évaluer la consommation intérieure et les marchés potentiels des IFT sélectionnés. Des questionnaires semi-structurés, interviews, discussions de groupe (FDG) et transects ont été effectués

pour documenter la diversité des IFT et leur utilisation dans la zone d'étude. Un total de 302 personnes a été interviewé. Les résultats ont montré qu'il y avait 34 arbres fruitiers indigènes comestibles dans la zone d'étude. Vitellaria paradoxa C.F.Gaetn, Phoenix reclinata Jacq, Ximenia Americana L, Vitex doniana douce, et Tamarindus indica L. ont été classés comme les arbres fruitiers prioritaires. Vangueria apiculata K. schum, Ximenia Americana L et Saba comorensis (Boj.) Pichon ont été perçues comme les espèces les plus menacées. Les résultats des enquêtes rapide de marché (RMS) ont montré que Vitellaria paradoxa C.F.Gaetn est l'IFT la mieux comprise, la plus protégée et la plus valorisée. D'autres espèces importantes sont: Tamarindus indica L, Carissa edulis vahl, Ximenia Americana L, Vitex doniana doux, Saba comorensis (Boj.) Pichon et Vangueria apiculata K. schum. Ces résultats révèlent la nécessité d'entreprendre d'autres études sur la valorisation des potentiels IFT tels que Tamarindus indica L, Carissa edulis vahl, Ximenia Americana L, Vitex doniana douce, Saba comorensis (Boj.) Pichon et Vangueria apiculata K. schum qui sont hautement préférés en raison de leur valeur commerciale.

Mots clés: Agro biodiversité, discussions de groupes, potentiel commercial des arbres fruitiers comestibles indigènes, utilisation

Introduction

Indigenous fruit trees (IFTs) have high potential in semi-arid and sub-humid regions as they can significantly contribute to food and nutrition security as well as to household income (Leakey *et al.,* 2005). Further, wild and semi-wild fruits can substantially boost rural income and employment opportunities in Africa (Leakey *et al*., 2005). Market and financial analyses in Southern Africa show that indigenous fruits can substantially contribute to household income, and that women and children are often the major beneficiaries (Ramadhani, 2002). Through value addition and fruit processing, indigenous fruits can provide higher value-to weight ratio and are easier to transport than timber or wood products (Saka *et al*., 2004). Indeed, Leakey *et al.* (2005) and Akinnifesi *et al*. (2007) indicated that harvesting, utilization and marketing of indigenous fruits are central to the livelihoods of majority of rural communities throughout Africa. Indigenous fruits can make a difference during periods of famine and food scarcity (Mithofer and Waibel, 2003).

The management of indigeneous fruits on farms and homesteads has been indicated as an effective way of reducing the sunk costs, and providing households with improved species diversity in terms of desired fruits and tree traits. There has also been increasing enthusiasm among researchers and development practitioners to explore the opportunities to meet the food needs of humanity and ameliorate climate change effects through planting of indigenous fruit trees (IFTs).

Focusing on wild collection and management of semi-domesticated trees on farm and homestead has been indicated as an effective way of reducing the sunk costs, providing households with improved species diversity in terms of desired fruit and tree traits (Kruse, 2006). Many IFTs support smallholder farmers in dry periods when production of other crops is low or almost impossible (Karachi *et al*., 1991; Maghembe

and Sayani, 1991). *Tamarindus indica* fruits for example can be harvested during such time for making tamarind juice (Kainja, 1991). *Borassus aethiopum*, *Sclerocarya birrea* and *Uapackir kiana* fruits can be gathered for making juices and wines while others can be processed into jam, chutneys and various animal feed concentrates.

There is increasing enthusiasm among researchers and development practitioners to explore the opportunities to meet food needs of humanity through indigenous species including indigenous fruit trees (IFTs). As such, domestication of IFTs has emerged as a farmer-driven, marked-led process and today, has become an important agroforestry initiative in the tropics (Leakey *et al.*, 2005; Akinnifesi *et al*., 2006; Tchoundjeu *et al.*, 2006). There is an increasing emphasis to promote IFTs by integrating them into the current farming systems especially in the semi-arid areas with economic potential as new cash crops. However, many farmers in Uganda regard indigenous fruit trees as wild and God given (Agea and Akullo, 2004) and have not considered them as a viable option to reducing food insecurity, improving dietary nutrition, averting climatic change effects and improving their livelihoods. Failure to domesticate IFTs has led to, among others, collapse of traditional seed banks, massive felling of IFTs, reduced farm diversity and increased food insecurity. There have been limited deliberate attempts to cultivate IFTs in Uganda. Unless concerted effort to explore opportunities to meet food requirements of the rural poor through enhancing on-farm production of IFTs, increasing emphasis on tree domestication strategies, commercialization and marketing is done, farmers will remain vulnerable to food and nutritional insecurity. Given the desirable attributes of IFTs for semi-arid zones, there is need to: (1) document and prioritize the existing biodiversity of IFTs and (2) to evaluate domestic consumption and market potential of the selected high value IFTs. Understanding these issues will provide a basis for incorporating IFTs into existing farming systems for increased food security, cash income, farm diversity and environmental resilience in Uganda.

Materials and Methods

This study was conducted in Otuke district, which is about 403.2 km from Kampala and 76 km from Lira town in Uganda. The district is located at 02°30′N 33°30′E coordinates. It has a total area estimated to be 1,549.8 km^2 (598.4 sq mi) situated at elevation of 1,200 m (3,900 ft). The study involved household (HH) studies, focus group discussion, transect walks and Rapid Market Assessments.

Two sub counties, six parishes and twelve villages were selected using stratified and simple random sampling procedures for the study. A total of 302 respondents were interviewed at household levels and two focus group discussions of 10 purposively selected individuals were conducted in the two selected parishes of Olilim and Ogor in Otuke district. In addition two transect walks of 2 km each with a radius of 200m from either side of the route were made to validate the list of the IFTs reported during the HH survey. In assessing market potentials, 150 respondents were drawn randomly from three main markets in Otuke district; “Patali / Cuk Apur” in Adwari Sub county, Olilim market in Olilim sub county, and Orum market in Orum Sub county.

Semi-structured questionnaires with lists of all the documented IFTs and provisions for adding IFTs that exist and yet not documented were used at HH levels to asses existing IFTs in the area. The semi structured questionnaire also probed for highly threatened IFT species most preferred; reasons for preferences, flowering and fruiting phenologies of the different IFTs; IFTs most consumed; parts utilized and when; factors affecting diversity; problems and opportunities for domesticating IFTs, among others. Prioritization exercises were conducted using participatory rapid appraisal (PRA) technique and up to 25 IFTs were ranked with respective weights / points attached to them. A mix of questionnaires, observation, audio recording and photography were used on a case-by-case basis during market surveys to capture key information such as indigenous fruits marketed in the study milieus, estimated quantities of indigenous fruits traded per known period, buying and selling prices, mechanisms of market price determination, promotional arrangements undertaken if any, constraints experienced in marketing the indigenous fruits and possible strategies to improve their marketing.

Data analysis

Household survey and ethno-botanical data were analyzed descriptively and inferentially using Excel and MINITAB statistical package. Mean frequencies of different variables/ citations sought were computed. Data from focused group discussion (FGDs) were subjected to in-depth content analysis, coding system and analytical comparisons. After each focus group session, recorded notes were reviewed and re-evaluated for their truthfulness and to identify the recurrent ideas that came out during the discussions. Tape recorded sessions of the group discussions were played and listened to again. Outcomes of the discussions were grouped according to key themes (topics). Key statements and ideas expressed for each topic explored in the discussion was identified and different positions that emerged under each key theme summarized. A systematic comparison was made on the emerging themes and positions (Neumann, 1994) to identify the common ideas. Exact phrases that represent each position/theme were pulled out. A full report of the discussion which reflects the outcome of the discussions as completely as possible was later prepared, using the participants' own words.

Data for diversity obtained from plots and transect walks were analyzed using descriptive statistics and the Shannon diversity Index.

$$H = \sum_{i=1}^{S} -(P_i)(\ln P_i) = -\sum_{i=1}^{S}\left(\frac{n_i}{N}\right)\ln\left(\frac{n_i}{N}\right)$$ (Magurran, 2004)

Where:
H = the Shannon diversity index
Pi = fraction of the entire population made up of species i
S = numbers of species encountered
∑ = sum from species 1 to species S

Market prices and weekly volumes of traded indigenous fruits were compared to some selected exotic fruits traded in the same locality. The profit margins (difference between

selling price and total cost of production) (Holland, 1998), were computed per traded fruits. Gross margin percent, which is calculated as the profit margin (difference in the selling price and the total cost) divided by the selling price (Holland, 1998), were also computed. In addition, data from market assessment was entered in excel, processed in Minitab and subject to gross marginal analysis and Analysis of Variance (ANOVA).

Results

Almost all (88.4%) of the respondents indicated that they had their land under IFTs and all the respondents (100%) had knowledge of IFTs. Up to 34 edible IFTs (Table 1) were observed and documented.

Table 1: Existing edible IFTs in Otuke District

Existing IFTs	Frequency	Percentage (%) Response
Ximenia Americana L.	302	100.0
Grewia mollis juss	302	100.0
Vitex doniana sweet	301	99.7
Bridelia scleroneura moll. Arg	299	99.0
Annona senegalensis pers	298	98.7
Tamarindus indica L	296	98.0
Vitellaria paradoxa C.F.Gaetn	295	97.7
Vangueria apiculata K. schum	294	97.4
Carissa edulis vahl	294	97.4
Sclerocarya birrea (Amarula)	290	96.0
Ficus glumosa Del.	289	95.7
Rhus natalensis Bernh. ex Krauss	287	95.0
Strychnos innocua Lam.	286	94.7
Saba comorensis (Boj.)Pichon	285	94.4
Borassus aethiopium mart	278	92.1
Ficus sur Forssk /Ficus ingens (Miq.) Miq.	273	90.4
Nauclea latifolius (smith) Bruce	235	77.8
Ficus sycomorus lam	216	71.5
"Ikum"	186	61.6
Syzygium malaccense (L.) Merr. and L.M.Pe	140	46.4
Grewia similis K Schum.	131	43.4
Ficus ovate vahl	127	42.1
Phoenix reclinata Jacq	125	41.4
Ficus natalensis hochst	121	40.1
Acacia polycantha Hochst.Ex A Rich	108	35.8
Margaritaria discoidea (Balt)Webster	102	33.8
"Odugu kulu"	90	29.8
Piliostigma thonningii schum	89	29.5
"Owelo otoo"	46	15.2
"Akere"	25	8.3
"Abelekec"	2	0.7

Out of the 34 IFTs reported, observed and documented, three of them were reported to

be highly threatened; 1. *Vangueria apiculata* K. schum reported by 64.3% of the respondents as highly threatened, 2. *Ximenia americana* L reported by 56.1% of the respondents as highly threatened, and 3. *Saba comorensis* (Boj.) Pichon reported by 25.3% of the respondents as highly threatened.

The IFTs in Otuke are consumed in various ways: raw as snacks, raw in salads, condiments /spices, jams / jellies, Juices, oils, porridge, boiled and wine. Over 90% of the people in Otuke consume most of the available IFTs raw as snacks. It is worth noting that, children are the major consumers of IFTs in the area and the elites are surprisingly the least consumers of IFTs as shown in the chart below;

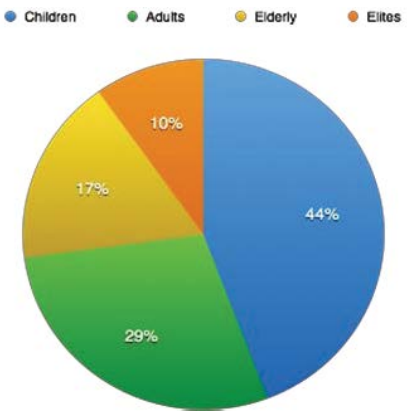

Fig. 1. Consumption of IFTs by different categories of people in Otuke.

The major reasons for preference and hence consumption of the IFTs above include; availability, taste, medicinal values, useful products e.g. soap, oil, juice etc., and adding flavor to porridge, among others. Most of the IFTs are consumed more than once a week when they are in season with a few consumed only once a year.

A number of factors were reported as hindrances to planting and managing IFTs on farmland (Table 2).

Discussion

This study documented up to 34 edible IFTs some of which are already threatened. This pattern can be attributed to increased bush burning, charcoal burning, changes in weather patterns and environmental conditions including inability of some IFTs to survive in swampy conditions (such as *Phoenix reclinata* Jacq and "Ikum"). Further limited availability of planting materials and an undeveloped seed system has hampered their propagation (Agea *et al.,* 2011). It is however important to note that there has been some interventions on the IFTs in the area.

Inorder to better manage IFTs, improvements need to be made in areas such as

community sensitization / trainings on their conservation and management, providing seedlings / promoting re-afforestation, provision of improved energy saving cook stoves, establishing bye-laws on the use of valuable IFTs like shea trees, sensitization on dangers of environmental degradation and establishment of forest committees at village levels by local government to monitor deforestation. Others may include conducting research and demonstrating propagation techniques of IFTs, training on advantages of consuming IFTs, training on dangers of bush burning, deforestation and importance of wetland conservation in addition to training on adding value to IFTs. These interventions will improve the level of knowledge and skills and improve consumption and marketing of IFTs in the area. These fruits are utilized in various forms / ways and confirms that indigenous fruit tree species are crucial for food security, nutrition and incomes (De Leeuw *et al.,* 2014).

Table 2: Factors hindering / affecting the planting and managing IFTs on farmland

Constraints that hinders farmers from planting and managing IFTs on their farmland	Frequency	Percentage (%) Response
Limited knowledge and skills on importance of IFTs	177	100.0
Limited planting materials	91	51.4
Limited markets for IFTS	67	37.9
Poverty	48	27.1
Drought	27	15.3
Wild fires	22	12.4
They take very long to mature	17	9.6
Pests and Diseases e.g. termites	16	9.0
Limited farm tools and equipments including inputs	7	4.0
Soil infertility	5	2.8
Limited land	5	2.8
Competition with other crops	4	2.3
Soil / Site selectivity	4	2.3
Little interest	3	1.7
Low prices for IFTs	3	1.7
Poor methods of conservation	1	0.6
Destruction by animals	1	0.6

Conclusion

Attention should be given to challenges that limits farmer conservation or management of IFTs if the diversity and abundance observed is to be sustained. Drivers to IFTs conservation and management that include market, relevant skills and knowledge should be provided to farmers. With more information and knowledge, IFTs have enormous potential in improving the livelihoods of the people in Otuken district that is currently characterized by chronic food and nutrition insecurity, poverty and generally poor levels of livelihoods sustenance.

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