Mixed Cropping Systems for Sustainable Domestic Food Supply of the Smallholder Farming Communities in Nakasongola District, Central Uganda

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ABSTRACT

Poverty alleviation and food security are the most important national priorities in Uganda. Development of agricultural technologies to improve rural livelihood through sustainable increase in production on crop, animal, and agroforestry products are the primary objective of the agricultural program in Uganda. This article presents the results of a study carried out to assess the sustainable use of multiple cropping patterns among farmers; and to determine possible combinations of socially valued fruit trees with annual crops. A survey was conducted between November 2017 and March 2018 in the parishes of Katuugo, Kyelindula and Kakooge of Kakooge Sub-county, Nakasongola district, central Uganda. A total of 220 farmers were interviewed using a structured questionnaire to elicit information on multiple cropping patterns and reasons for such mixtures. The results showed that farmers characteristics determined the multiple cropping patterns. Beans/maize/cassava cropping was the most prominent among farmers. Family income and sustainable domestic food security were the most prevailing reasons for multiple cropping. The study has provided information on the long-practiced method of multiple cropping by farmers, common food crop mixtures and their reasons for using multiple cropping patterns.

Keywords: *Crop mixture, Food crops, Extension services, Smallholder farmers.*

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1. INTRODUCTION

In Uganda, arable land comprises of 75% of the total land area, but only 10% can be considered as agriculturally productive land and yet the total land area of Uganda is 241,000 km^{-2} of which more than 25% is unproductive [1]. These agriculturally unproductive areas include swamps, mountains, national parks, urban centers and open water. The remaining land surface is rated as moderate, implying the sort of soils that will support crops under good management. About 85% of the population is peasant farmers living in the rural areas, which are the mainstay of agricultural production [1]. These farmers operate on a small scale with farm holdings of 1 - 2 hectares, which are usually scattered over a wide area. About 75% of Uganda's land is under arable cultivation with a land-human ratio of 58 persons per square kilometer in Central Uganda. This shows that the average size of farmlands is very small.

The production practices of smallholder farmers are synonymous with their production characteristics such as subsistence level of production, low hectare due to tenurial rights. Other factors include poor access to credit and other production inputs, poor managerial ability and enterprise combination as informed by ecological considerations, available resources, taste and preferences of farm families.

Poverty alleviation and food security are the most important national priorities in Uganda. Development of agricultural technologies to improve rural livelihood through a sustainable increase in production and productivity on crop, animal, and non-timber forest product is the primary objective of the agricultural program in the country [1]. Limited land holdings and preferences for cereals to fulfill the immediate basic needs along with a shortage of rural labor due to migration to cities has raised critical issues at local farm management level [2]. Trees farmland has affected the production of cereals by competing with soil nutrients, light and water resources influencing the livestock productivity and thereby livelihood of the rural farmers. Thus agroforestry systems with increased productivity to fulfill local food demand and to provide employment opportunities and income generation should be the vision of agriculture and agroforestry in Uganda [3].

There has been a great investment in agricultural research and development of new technologies in Uganda [1]. Many technological innovations most of which are appreciated or used by the farmers. According to Semana, et al. [4] inadequate participation of rural farmers in the agricultural technology development is partly responsible for the inability of farmers to take full advantage of the improved agricultural technologies [5]. Agricultural technology development among smallholder farmers is still very low. To improve the agricultural production, appropriate technology is necessary to suit the local economic, cultural and geographical conditions of the region [6].

A diversified enterprise-oriented economy is a typical feature of the most rural economy in Uganda [1]. Another factor that informed the combination of enterprises is a great deal of uncertainty under which farmers produce. It could be inferred that the proximate risks experienced by small-scale farmers were sufficient to completely mask any differences in the household managerial ability. According to Agea and Fungo [7] the risk of production and reliance on the market virtually force poorer producers to adopt subsistence-oriented strategies. It, therefore, implies that a farming system had been evolved which emphasizes multiple cropping systems in order to hold forth for the risky nature, though subsistence becomes more pronounced.

Food security, as against food production, is concerned with access to food. If food is in fields or in the markets, but families cannot afford to acquire it, then they are food insecure. A household is a food secure if it can reliably gain access to food in sufficient quantity and quality for all its members to enjoy a healthy and active life. Lack of availability of and access to food, the key factors behind food insecurity – remain central concerns in Uganda.

Particularly in rural parts of Uganda, agriculture and the market system are important components of whether individuals and households can be food secure. Raising agricultural productivity remains the most patent force for

reducing food insecurity. Higher production and productivity on one's own farm enhance household food security. However, poverty constrains the ability of farming households to invest in productive assets and agricultural technologies. Moreover, poor market systems result in high costs of inputs and low prices for farm outputs, providing poor economic incentives for farmers to invest in yield-enhancing sustainable agricultural production systems. Moreover, for both rural and urban Ugandans, stable access to food through the market requires that the food marketing system is effective in supplying food, while also providing benefits to farmers who have food to sell. Yet efforts within agriculture alone, if conducted in isolation from activities in other sectors such as marketing, health, and education, will not bring food security to the many under-nourished Ugandans.

In Nakasongola district, the cultivation of food crops without fallow for many years has led to serious soil erosion. The lag in agricultural productivity advancement behind population growth has caused intense land use conflicts, particularly between the agricultural and the forestry sectors. To compensate for the low agricultural productivity, deforestation for arable land expansion has been the principal land use conversion employed in Uganda and in particular in Nakasongola for centuries [8]. There are several repercussions of such land use conversion, the most important in Uganda's and in particular in Nakasongola context being accelerated soil erosion and deterioration of soil nutrient status. However, Nakasongola is known not only for the severity of land degradation, but also, since the last decades, for the concentrated efforts taking place to redress these problems including construction of stone terraces and soil bunds, closed areas and afforestation.

Past studies [9] have identified some of the smallholder farmers' characteristics that may influence adoption rate of agroforestry technologies including age of the household head, education level of family head, gender, wealth, family size, group membership and farm resources such as farm size, land tenure, credit, or other inputs and labour. There has been no research conducted on farmlands to assess the sustainability of long-practiced multiple cropping patterns and agroforestry systems.

The objectives of this paper are two: (i) examine of multiple cropping patterns among smallholder farmers with regard to the farmer's characteristics, food crop mixtures, (ii) identify the reasons why farmers prefer multiple cropping patterns, (iii) determine possible combinations of socially valued agroforestry fruit trees with annual crops.

2. MATERIALS AND METHODS

2.1. Study Area Description

The study was conducted in Nakasongola District 114 km north of Kampala (Figure 1). The district covers an area of 3,424 km^2 of land on the central plateau between 1000 and 1400 m above sea level. The topography is characterized by extensive uniform undulating plains with broad seasonal swamps. The soils are predominantly weathered basement complex formations of the precambrian age, which consists mainly of metamorphic and igneous rocks, largely composed of gneisses and granites. Remnants of marram and ironstones are a relic of the older mid-tertiary surface geological processes [10].

The annual rainfall varies from 875 – 1120 mm with two distinct dry seasons and the average temperature ranges between 22.6^0 C and 24.6^0 C. The main vegetation types are woodland and woodland savanna, thicket and softwood plantations of mainly *Accacia-Combretum* continuum associated with *Hyperheria*. Cultivated land are patches in the woodland.

The district has a total population of 528,126 people, the population density is about 230 persons per km^2, and the growth rate is 2.7 %. The ethnic groups include the Baganda (70%), Baruli (28) and others (2%). 89% of the population are subsistence farmers [11].

2.2. Data Collection

The primary data were obtained from smallholder farmers in the parishes of Katuugo, Kyeyindula, and Kakooge of Kakooge Sub-county (Figure 1). Food crops grown include maize, beans, cassava, millet, banana, sweet potatoes, pumpkin, soybean, and sugar cane under mixed cropping practices. The target population of this study consists of smallholder farmers. The sample size included 160 farmers' groups which were formally registered and recognized by the National Agricultural Advisory Services (NAADS). Each group has between 30 and 35 members. Ten-percent (16) of the registered and viable farmers' groups were randomly selected. Out of 542 total members, fifty percent were randomly selected (220) for interviews.

Both secondary and primary data was used in this study with the former comprising of literature from various sources and the latter including demographic, socio-economic characteristics and agronomic practices obtained from the farmers. Information was obtained through the research questionnaires formulated plus personal observations made during the fieldwork process. The interview schedule was employed in obtaining information on demographic characteristics, common crop mixtures and reasons for multiple cropping patterns. The instrument for data collection was subjected to pre-testing, validation and reliability tests which gave a reliability coefficient of 0.76.

2.3. Data Analysis

Data were analyzed using statistical programming for social scientist sciences (SPSS ver. 11.0) and simple descriptive and inferential statistics were run. This was accomplished through the coding of the responses from the interview schedules into the computer programme. Simple descriptive statistics such as frequencies, means and cross-tabulations were performed to establish the socio-economic profile of the area under study. The frequency count of the multiple responses of the smallholder farmers was ranked to identify their reasons for multiple cropping patterns.

3. RESULTS AND DISCUSSION

3.1. Smallholder Farmers' Personal Characteristic

Out of the 220 farmers interviewed, sixty-five percent were male-headed households (Table 1). This finding implies that farming is still dominated by the male population. In Uganda, very few women own productive resources including land or trees and are often excluded from decision making for many agricultural activities. This affects agricultural productivity, economic efficiency, and growth. Traditionally, the household head is the main decision-maker and since most of the households are male-headed (65%) it implies that they play an important role in the agricultural sector. This may be the result of the lack of consideration of gender-equity issues in the design and introduction of technology to farmers.

We can attribute the lower participation by women to the fact that in the study are, women still do not have secure land and tree tenure due to the largely patrilineal inheritance systems. Only old women, widows and female-headed households are often able to have access to more secure land rights. Studies conducted in Malawi [9] and Kenya [12] showed that the average female-headed household did not adopt modern multiple cropping patterns compared to the male-headed farm household. It is important to address this inequality by introducing women farmers to other technologies that do not require secure long-term land and tree rights. This could include improved fallow technologies with leguminous shrubs or mixed intercropping with leguminous shrub species.

Half of the sample respondents (50%) were between 31 and 45 years and their mean age was 45.6 years; which suggests that farming has become an occupation of the middle age group. About 66% were married and this could

be attributed to the general belief that married households have the family labour force required for mass production. Similar studies conducted in Africa [8] reported that marriage provides additional farm labour for the household and this fact explains the high propensity for polygamous families.

Three types of labour were reported in the area of study and these included; family hired and communal. Family labour is the most prominent, accounting for 57 percent of the households interviewed. Hired labour was indicated by 35 percent while only 8 percent of the household interviewed reported practice of communal labour. The majority of the small-scale farmers interviewed across the study area indicated to have sufficient labour capacity to carry out their farming activities in the growing season. However, in Katuugo village there was insufficient labour capacity possibly because of the available off-farm employment opportunity such as the lucrative roadside trading and charcoal burning. The survey results indicated that 75 percent of the small-scale farmers had attained appreciable education where 29% had formal education and 47% had an informal education. Only 24% were not educated. The farmers had attained significant literacy levels as a result of the government human development programmes aimed at improving the general standard of living of the rural population. Government programmes have been complemented by the intervention activities of non-governmental organisations (NGO), such as Integrated Development Initiatives (IRDI), Action for Community Development (ACD), operating in the area of study. This study revealed that about 43% of the farmers had been practicing farming for 21 to 30 years, followed by those who have been farming for10 to 20 years (32%). These results were supported by rampant rural-urban migration of the productive, youthful population in Uganda which is accelerated by the poor returns from farming compared to gainful employment in the industrial sector found in urban centres. This finding is consistent those of Boesen, et al. [6] reported that non-formal education through extension work plays an important role of awareness creation to people who have not received formal education to acquire skills. Semana, et al. [4] who reported that a higher education level, is associated with greater information and higher management expertise. The households which practice viable multiple cropping systems have family members who were young and more educated. The education level of the head of the house was found to be an important determinant of multiple cropping patterns in this study.

Table-1. Farmers' personal characteristics (n = 220)

Variables		Frequency	Percentage
Gender	Male	142	64.6
	Female	78	35.4
Age	15 – 30	16	7.3
	31 – 45	110	50.0
	46 – 70	82	37.3
	> 70	12	5.5
Marital Status	Single	76	34.5
	Married	144	65.5
Education	Formal	66	29.1
	Non-formal	102	47.3
	Not educated	52	23.6
Farming Experience	< 10 years	24	10.9
	10 – 20 years	72	32.7
	21 - 30 years	96	43.6
	> 40 years	28	12.7
Labour capacity	Family	125	57
	Hired	77	35
	Communal	18	8

Source: Primary Field data, 2018

Similar findings [8, 9] reported that education is positively associated with the probability to adopt modern cropping technologies. They based their argument on the fact that formal and informal training has the potential to increase the rate of adoption by directly increasing awareness, imparting skills and knowledge of the new agricultural technology. The farmer's education level positively influences the probability of introducing multiple cropping patterns in the farming system. Better-educated farmers are able to better understand the nutrient cycling processes underlying the agricultural technology [1]. Well educated farmers modify the technology to incorporate the benefits of a fallow as they traditionally do in their bush fallow rotation system.

3.2. Crop Mixture

The smallholder farmers' awareness and perception of the relevance of appropriate crop combinations has a significant impact on the sustainability of the land resource and soil conservation. Crop mixture is a common feature of crop production across the study area. Intercropping of bean and maize was ranked as the first. This may be due to the fact that the two crops are major staples in the study area. Cassava a drought-resistant crop is usually intercropped with maize and the combination was ranked second. This may be attributed to the importance of cassava as a source of cheap calories. It is also processed and consumed in various forms. With the advent of better post-harvest technology, cassava will be turned into a major source of ethanol for fuel, energy in animal feeds and starch for industry [13].

The main economic activity is agriculture engaging 82% of the household population. Annual crops grown are maize, cassava, millet, sweet potatoes, beans, soybeans, vegetables and groundnuts for subsistence (72%) and commercial purposes (26%). The perennial crops include banana varieties as food and commercial crop and coffee as a cash crop. The third-place combination on the ranking list is maize/cassava/bean. The reason for this may be because of the incorporation of beans to re-enforce the nitrogen-fixing potential of the farming system.

Table-2. Preferred crop combinations among smallholder farmers

Crop mixtures	Frequency*	Rank
Beans/maize/cassava	200	1
Beans/cassava/sweetpotatoes	192	2
Beans/maize	187	3
Beans/maize/sweetpotatoes	150	4
Beans/maize/cassava/millet	136	5
Maize/banana/cassava	134	6
Maize/banana	130	7
Bean/cassava	111	8
Cassava/maize/banana/millet	95	9
Maize/bean/banana	92	10
Maize/bean/cassava/banana	92	11
Cassava/bean/sweetpotatoes	85	12
Maize/sugarcane	72	13
Cassava/millet/maize	69	14
Cassava/bean/maize	62	15
Soybean/maize/cassava	48	16

* = Multiple responses

While several crop combinations acquired differing positions in Table 2, Soybean/maize/cassava combination was ranked as the least popular mixture among farmers. Soybean, is a grain legume, requires many agronomic practices, which entail the use of inputs that are not easy to come by for the farmers. Its inclusion then in the traditional farming systems is more to answer for the gender differences since it is widely regarded as a woman's crop.

In a related study, Agea and Fungo [7] reported that crop mixtures among farmers greatly depend on factors such as lack of information, crop operations interference, lack of money, lack of seedlings, past mortality, lack of land, lack of control over the land resource, distance to farm, labor scarcity. Land ownership and labor availability were identified as the two most significant factors contributing to agroforestry adoption because of increased security and risk aversion.

3.3. Crop Mixture as a Resilience Strategy

Table 3 shows that ensuring food security for the farm families was the major reason for the multiple cropping patterns. In this case, household food security implied having food available around the year (Table 3).

Sustainable domestic food supply is the second most important factor considered by the farmers as they choose their crop combinations. According to MAAIF [1] Uganda faces significant problems of malnutrition and for the past 20 years there have been deep pockets of famine and hunger due to natural and man-made shocks, particularly delayed rains and civil strife. Over 40 percent of deaths among Ugandan children can be attributed in part to malnutrition. Over 38 percent of children below 5 years of age in Uganda are stunted, being significantly shorter than they should be given their age, while 22.5 percent are underweight for their age. Micronutrient deficiencies are common. Iron deficiency anaemia affects slightly more than 50 percent of the population, while 10 percent of Ugandan women are undernourished. The total goitre rate due to iodine deficiency is over 60 percent. These challenges make it imperative for the farmers to plan crop combinations that will offer maximum solutions.

Table-3. Farmer's considerations for crop combinations on farmland

Reasons	Frequency*	Rank
Family income generation	193	1
Sustainable domestic food supply	174	2
Environmental synergetic effect among crop	129	3
Crop compatibility	102	4
Nutrition security	100	5
Available crop extension services	88	6
Marketability and price	87	7
Pest and disease resistance effect	57	8
Tastes and preferences	52	9
Maturity season	34	11
Compatible with agroforestry farming practices	30	12
Gender factor and preferences	25	13
Socio-cultural-political considerations	22	14
Post-harvest handling and storage requirements	21	15

** = Multiple response

Environmental synergetic effect among the crops is the third in the order of importance. This is based on the principle that different crops demand different nutrients from the soil. The old, lateritic soils loss easily their fertility and require crop rotation that tends to allow for soil rejuvenation when crops with different demand on the soil are grown in sequence. The fact that cassava is used as a fallow crop may justify its inclusion in the cropping system.

Crop compatibility was identified as the fourth consideration that farmers use to decide crop mixtures on their farmland. This might have been the product of their own traditional practices over years. This is closely followed by the reduction in the cultural practices that multiple cropping enhances. The farmers reported that they do less of weeding when multiple cropping is practiced as against sole cropping. This has gone a long way to reducing the menace of weed infestation that is often responsible for yield reduction.

Nutrition security was ranked fifth in importance because nutrition insecurity is an important component of the development challenges that Uganda faces. There is a need to reduce the health burden at the individual and household level arising from food and nutrition insecurity. The economic burden of malnutrition on the household has far-reaching national effects as the preventable problem of malnutrition translates into reduced aggregate economic productivity, reduced intellectual capacity and general human capital erosion, increased cost of care and increased demand for health services. Food and nutrition insecurity fundamentally undermines efforts to meet the vision of the Poverty Eradication Action Plan (PEAP). It is in view of comprehensively addressing these problems that the Food and Nutrition Strategy and Investment Plan are needed.

Availability of crop extension service was another factor farmers considered in choosing a particular crop combination. The farmer's contact with the extension staff is still more important in this study area. The uptake of new technologies is often influenced by the farmer's contact with extension services. Farmers with access to technical information through extension contact will have more accurate information to do a cost-benefit analysis of the crop mixture pattern. Our study supports the findings of Buyinza [13] who reported that community uptake of any innovation, technology or agricultural practice will be accelerated if farmers have an accurate understanding of the principles underpinning extension recommendations.

Other reasons given by the farmers include that multiple cropping practices is perceived as a measure against crop failure. Farmers know that different crop would survive differently under varying ecological stress and pest attack, therefore to spread the risks they grow multiple crops and trees on the same unit of land.

Some of these crops serve as insurance such that they can be harvested at any time to make up for debt or some other sudden needs. This is true of cassava crop and this is why it features in most crop combinations. Turyahabwe, et al. [3] reported that successful integration of trees onto agricultural land necessitates that the species and their management and use must be compatible with the farming system in biophysical, economic and social terms. They noted that problems of resource depletion are less likely to occur when production is carried out on private agricultural lands where biophysical and social factors are well considered.

3.4. Agroforestry Tree Species in Crop Mixture

The study sought information about the effect of socio-economic characteristics such as education levels, age, sex of the household head, family size, income level, occupation, farm size, landholdings, land tenure status, extension services to the domestication of wild woodland tree species.

From a household perspective, the adoption of any technology depends on whether the returns from new initiatives are greater than the existing practices. The experience shows that introduction of location suitable agroforestry and intensification of traditional farming practice to improve income is economically viable. Farmers have been practicing different systems and combinations that are more productive and compatible to the area-specific farming systems in the hills. Practices adopted by the farmers have been contributed to family income generation, food security, soil conservation and fertility improvements [8].

Agroforestry makes it possible to grow different plant species which can be used as fuelwood, fodder, food supply and regenerative alternative energy at the farm level to substitute fuelwood from the forest, agricultural residues and animal waste that are being used as energy sources. Similarly, promotion of different species including aromatic plants is a potential source of farm income. Modification of management options, the inclusion of cash crops and modification of the technology to suit to local biophysical and socio-economic conditions should be considered. In view of escalating agricultural intensification and population growth threatening the productivity of

farming systems, promoting the use of cash-earning fodder species and alternative sources of farm income will contribute considerably towards sustainable economic development in the hills.

The study highlighted that the customary land ownership was the most common land tenure system in the area. All the households holding land under the leasehold tenure system were unwilling to plant wild woodland fruits (table 4). A chi-square test indicated a significant difference (P = 0.005 at 95% confidence interval) in the willingness to plant fruit trees on farm basing on the landholding system.

Focus group discussions revealed that although most of the people do not own land titles, it has not affected their willingness to plant trees because of the fact that the woodland tree species are considered of low commercial value compared to timber producing trees, therefore, farmers holding land title deeds are not interested in tree domestication.

Table-4. Effect of landholding to plant woodland fruits

Landholding	**Willingness to plant wild woodland fruit trees**		
	Willing	Not willing	Total
Customary	28	0	28
Communal	3	1	4
Lease hold	0	4	4

Source:: Primary Field data, 2018

According to Galabuzi, et al. [14] the primary factor governing rights to plant and use trees is the tenure status of the land on which they are found. Tenure of woodland resources is related to the land tenure and management system of the woodland in question.

In the study area, woodlands consist of three major landholding systems: farmer managed private plot, large areas, which are utilized communally and gazetted woodlands under Uganda Forest Department. These three major types of land management have resulted in uncoordinated exploitation of woodlands and the overall degradation of their potential resources [3].

3.5. Possible Combination of Wild Fruit Trees with Annual Crops

The mixtures of various agricultural crops and fruit trees meet the basic fruit needs of local populations, while the multi-storied configuration and species diversity of home gardens help to reduce the environmental deterioration [3]. In an effort to improve smallholder production of staple foods, home gardens appear to be a sustainable alternative to domestic food production. The majority of the households interviewed preferred scattered trees on cropland (Table 5).

Table-5. Preferred fruit tree species and preferred tree configuration on farm

Preferred Tree Species	**The main source of fruits in the household and preferred tree configuration on farm**			
	Along boundaries	**Scattered on cropland**	**Along boundaries**	**Scattered on cropland**
Carrisaedulis	1	30	0	1
Tamarindusindica	1	25	0	6
Ximeniaamericana	1	24	0	7
Vangueriaapiculata	0	14	0	17
Borassusaethiopum	2	14	4	15
Rhus vulgaris	6	13	17	0

Source:: Primary Field data, 2018

Most of the trees (84 %) are scattered in crop fields and they are grown for the production of various products such as poles, firewood, fruit, timber, fodder, and medicine. Galabuzi, et al. [14] reported that woody perennials are less affected than herbaceous plants by temporary water deficit and hence agroforestry systems make it possible to increase directly or indirectly the production of food, both in quality and quantity, notably by greater product diversity. Their effect on the environment is positive and they contribute to the maintenance and fertility of soils, to deducing wind speeds to creating micro-climates favourable to crops and to load capacity. They also provide many other products such as forage, fruits, tanning flowers, medicines, dyes, and firewood.

The vast diversity of fodder tree species available in Nakasongola district should be utilized fully to the uplift livelihood of rural people. About 250 different varieties of fodder trees have been identified while about 90 species are recorded being used by farmers. Diverse type of Non-Timber Forest Product (NTFP) species and tree species for the industrial purpose are available having a high potential for raising farmers' income. Potentialities of these fodder trees, NTFP, industrial tree species are yet to be identified. The vast diversity of fodder tree species, NTFP species, grasses, medicinal herbs and tree species used for the industrial purpose should be utilized fully to uplift the livelihood of rural people [8].

Marked variations were reported in tree species preference according to gender needs. The fruit tree species with a high market potential are most preferred by men. This is due to the potential revenue likely to be obtained through selling the products. Our survey results show that women preferred those tree species with a lesser market potential. Strategically, having more products available for domestic use. It is women and children who collect fuelwood, animal fodder, decayed leaves and other tree products.

3.6. Gender Relations

Gender relations play an important role in food security and nutrition management in the household and community. Gendered aspects of food and nutrition security tend to be largely ignored in attempts to address food insecurity and malnutrition and yet there is considerable instrumental benefit from adopting a gender perspective on food security and nutrition. Nutrition-oriented activities are inherently gendered. Women are the nutrition care-givers in societies, they grow food and cook, all of which are critical determinants of nutritional status.

Specifically tailoring food security and nutrition intervention with a clear understanding of the differing roles that men and women play in assuring the food and nutrition security of households will lead to more effective interventions.

Table 6 shows that *Tamarindusindica* was ranked first by males whereas it was least preferred by females. The women preferred tree species in the ranking order of *Borrassusaethiopum*, *vangueriaapiculata*, *Rhusvulgaris*,*Ximeniaamericana*wheras the men preferred *Tamarindusindica*, *Carrisaedulis*, *Ximeniaamericana*, *Rhusvulgaris*, and *Vangueriaapiculata* respectively.

Table-6. Ranking of wild woodland fruits by sex

Rank	Species rank	
	Males	**Females**
1	Tamarindusindica	Borassusaethiopum
2	Carrisaedulis	Vangueriaapiculata
3	Ximeniaamericana	Rhus vulgaris
4	Rhus vulgaris	Ximeniaamericana
5	Vangueriaapiculata	Carrisaedulis
6	Borassusaethiopum	Tamarindusindica

Source:: Primary Field data, 2018

The majority of farmers (80%) reported that the most beneficial tree species irrespective of gender are *Carrisaedulis*, *Tamarindusindica*, and *Ximeniaamericana*. This trend in species preference is due to benefit sharing and economic output sharing. Fruit tree species with a high market potential are most preferred by men this is due to the potential revenue likely to be obtained through the sale of the products.

Although the women's needs often differ from those of men, many programmes tend to overlook women's specific needs regarding forestry. This has resulted in political, cultural and economic barriers that restrict women's participation. Policy-makers lack adequate data, information, and methodologies to address them. It is imperative to note that where forest resources are central to sustainable livelihoods and reducing poverty, local people especially women should be stakeholders in policy formulation and decision making [13].

During the household survey, we observed that generally women preferred those species with a lesser market potential. This will decrease on the chances of their husbands selling off the fruit for cash thereby make them available for domestic use. This would then improve on the fruit security status of the households. We further discovered that some of the fundamental issues related to women and tree resources are connected to the traditional bias and social constructs against women [12].

This was attributed to the commercialisation, modernisation and compartmentalisation of agriculture and forestry, which place a high priority on monocultural designs. On the other hand, it is associated with the technological and strategic approaches developed and designed by the male-dominated sectors. These have formally marginalized women, particularly the socially and economically backward ones who carry the indigenous knowledge, technology, practices, and skills. In order to rescue the most valuable forest resources, an attempt has been made to place priorities on forestry and women, on the assumption that women's enrolment in forestry would enable them to achieve successful implementation of forestry programmes [12]. *Rhusvulgris* is a tree species which forms a dense thicket which is likely to restrict movement in home gardens. For this reasons, it was preferred as a boundary tree species by households which were willing to plant it as fruit tree species. *Tamarindus indica* is the only species that was observed to be semi-domesticated in gardens left after woodland conversion to farmland. This is probably because of its potential to provide marketable fruit output quantities and quality during hunger periods.

While women normally have multiple, often disproportionate responsibilities, they have little ownership or control over productive resources [7]. This imbalance in the ownership and control of resources places women in a subordinate and disempowered position relative to men. They are forever dependent. As a consequence, women and men have contrasting perceptions, priorities, and goals and as a result development interventions affect them differently.

The gender imbalance between rights and responsibilities influences all rural peoples' abilities to apply their ecological knowledge and constrains their efforts to provide for their families and protect the complex ecosystems on which they depend [3]. The success of equitable tree resource conservation in communities depends mainly on a collective ability to restore diversity and complexity to the life support and livelihood systems and to learn from and support both men and women who live within the living landscape.

4. CONCLUSION AND RECOMMENDATIONS

Based on the findings of this study, it is evident that crop mixture is a common feature of crop production across the study area. Intercropping of bean and maize was ranked as the first.

Crop mixtures as a practice of multiple cropping go beyond the conservative attitude of local farmers but have proved to be an effective means of evolving sustainable livelihoods for the farm families, soil conservation, nutrient enhancement, crop insurance, and meet the diversified tastes and preferences of the household members.

Agricultural extension policy should shift from its long-time prescriptive focus of recommending pre-packaged techniques towards an emphasis on efforts meant to make up for low educational attainments in rural farming communities. This can be done by educating farmers on scientific principles of good crop mixture and focusing on training activities meant to improve their management skills [9].

There exists marked variations in tree species preference according to gender needs. The fruit tree species with a high market potential are most preferred by men whereas women preferred those tree species that contribute to household food security in form of fruits, fuelwood, animal fodder, decayed leaves and other tree products.

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REFERENCES

[1] MAAIF, "Ministry of agriculture, animal industries and fisheries. National agricultural advisory services programme," Master Document of the NAADS Task Force and Joint Donor Groups. MAAIF, Entebbe, Uganda, 2001.

[2] N. D. Vogt, A. Y. Banana, W. Gombya-Ssembajjwe, and J. Bahati, "Understanding the long term stability of West Mengo forest reserve boundaries," *Ecology and Society*, vol. 11, pp. 38-48, 2006. *View at Publisher*

[3] N. Turyahabwe, C. J. Geldenhuys, S. Watts, and J. Obua, "Local organizations and decentralized forest management in Uganda: Roles, challenges and policy implications," *International Forestry Review*, vol. 9, pp. 581-596, 2007. *View at Google Scholar | View at Publisher*

[4] A. R. Semana, R. Percy, and P. Kibwika, "Sharing experiences on participatory technology development," Dept. of Agricultural Extension/Makerere University and International Rural Development Department, the University of Reading, 2002.

[5] NARO (National Agricultural Research Organization), "Outreach and partnership initiatives: A strategy for decentralization and Institutional learning," *Entebbe. Working Paper, No.1*, 2001.

[6] J. Boesen, R. Miiro, and S. Kasozi, "Basis for poverty reduction? A rich society, farmer innovation and agricultural service provision in Kabale, Uganda," *DCISM Working Paper*, 2004.

[7] J. G. Agea and B. Fungo, "Efficacy of forestry conservation policy on rural livelihoods in Uganda. Evidence from Mabira Forest reserve," *Social Sciences*, vol. 4, pp. 295-303, 2009. *View at Google Scholar*

[8] A. Y. Banana, N. D. Vogt, J. Bahati, and W. Gombya-Ssembajjwe, "Decentralised governance and ecological health: Why local institutions fail to moderate deforestation in Mpigi district of Uganda," *Scientific Research and Essay*, vol. 2, pp. 434-445, 2007. *View at Google Scholar*

[9] M. Nyirenda, G. Kanyama-Phiri, A. Bohringer, and C. Haule, "Economic performance of improved fallow agroforestry technology for smallholder maize production in Central Malawi," *African Crop Science*, vol. 5, pp. 638 – 687, 2001. *View at Google Scholar*

[10] NEMA National Environment Management Authority, *District environnent profile.* Uganda: Nakasongola District, 2000.

[11] UBOS, "Uganda bureau of statistics," Uganda National Household Survey 2014/2015; Report on the Socio-economic. Ministry of Finance and Economic Development, Government of Uganda Printery, Entebbe, Uganda2015.

[12] R. A. Swinkels, K. D. Shepherd, S. Franzel, J. K. Ndufa, E. Ohlsson, and H. Sjogren, *Assessing the adoption potential of Hedgerow intercropping for improved soil fertility in Western Kenya. In: Franzel, S.and Scherr, S. J (Eds), Treeson the farm-assessimg the adoption potential of agroforestry practicesin Africa*. Wallingford, UK: CAB International, 2002.

[13] M. Buyinza, "Financial efficiency of improved fallow agroforestry technology for bean production in Kakoonge Sub-County, Nakasongola District, Uganda," *Nepalese Journal of Development and Rural Studies*, vol. 4, pp. 68 -79, 2008.

[14] C. Galabuzi, G. Eilu, L. E. K. Mulugo, and J. R. S. Tabuti, "Strategies for empowering the local people to participate in forest restoration," *Agroforest Systems*, vol. 88, pp. 719-734, 2014. *View at Google Scholar | View at Publisher*

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