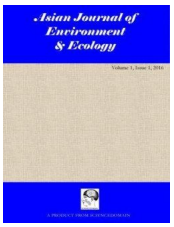

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An Inventory of Agroforestry Practices in Butta Sub-County, Manafwa District, Uganda

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Authors' contributions

This work was carried out in collaboration between all authors. Author SK designed the study, performed the statistical analysis, wrote the protocol and wrote the first draft of the manuscript. Authors SK, SH and UAU managed the analyses of the study. Authors SK and IM managed the literature searches. All authors read and approved the final manuscript.

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ABSTRACT

Background: Agroforestry is being regarded as an effective, low-cost means of minimizing the degradation of cultivated land and of maintaining or even increasing the productive capacity of agricultural ecosystems.
Aim of the Study: This study aimed to develop an inventory of agroforestry practices and constraints among small-scale farmers in Butta sub-county, Manafwa district in Uganda.
Methodology: The study was conducted with the heads of household selected using a combination of multistage stratified random sampling and systematic random sampling. The study population of this research involved two categories of respondents that are the household and extension officers from the sub-county. The quantitative data collected from the household heads were analyzed using Statistical Package for Social Science (SPSS) version 20.0 and Microsoft office excel 2013. Descriptive analysis was conducted to estimate frequencies and percentages of the responses. Friedman test was conducted to identify the most critical constraints associated with agroforestry adoption.

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Results: Five practices were identified and these range from Boundary marking, live fences, hedges, woodlots to Home gardens. The most significant constraint was Pest and diseases with mean rank 1.24 followed by fire outbreak, Lack of labor, Drought, Shortage of land, and lack of seedlings and Theft with mean rank of 1.32, 2.11, 2.41, 2.53 and 3.11 respectively.
Conclusion: Boundary planting is the most widely adopted practice while woodlots were the least. Wives and children are the main farm labor providers and therefore farm labor is often available when the children are on holiday since most of them attend boarding schools.

Keywords: Agroforestry; home garden; adoption; inventory; constraint.

1. INTRODUCTION

The association of trees, agricultural crops and animals in a farming system is an ancient practice throughout the world, probably dating back to 7000 B.C, in the form of shifting cultivation [1]. Agroforestry has been defined as a dynamic, ecologically based, natural resource management system that, through the integration of trees on farms and in the agricultural landscape, diversifies and sustains production for increased social, economic and environmental benefits for land users at all levels [1]. Agroforestry and conservation agriculture have emerged as a sustainable land management practices addressing land degradation and loss of soil fertility [2]. It is regarded as an effective, low-cost means of minimizing the degradation of cultivated land and of maintaining or even increasing the productive capacity of agricultural ecosystems. By World Bank estimates, over 1.2 billion people derive their livelihoods from agroforestry systems. Owing to its capacity to enhance multiple functions in agriculture, agroforestry will become increasingly important in land-use practices around the world [3]. If properly conceived and practiced, agroforestry can contribute to sustained productivity of natural resource base by enhancing soil fertility, controlling erosion, enhancing microclimate of cropping and grazing lands and general improvement of the environment [4,5]. The importance of agroforestry in Africa can therefore, not be under-stated. As one kind of land use practice, traditional agroforestry systems already have a long history of hundreds of years in practice and still play a significant role in the world today, especially in tropical and sub-tropical areas. In this era of globalization and food insecurity, more and more governments and non-governmental organizations are paying attention to traditional agroforestry systems because of their economic, ecological and socio-culture benefits. These benefits are also in accord with the characteristics of Globally Important Agricultural Heritage Systems (GIAHS) [6].

Since 1988, Agroforestry research in Uganda has focused on identifying tree species that could be incorporated on agricultural land without significantly interfering with food crops. Several Agroforestry practices were been introduced and promoted in the country, mainly by the International Center for Research in Agroforestry (ICRAF) and the Uganda Forestry Resources Research Institute (FORRI) in collaboration with number of non-governmental Organizations (NGOs). Practices for soil fertility improvement, production of fuel wood, timber, fodder, fruits and other products was being tested on both research stations and farmers' fields in several districts in the country. Many of the Agroforestry activities were been targeted in areas with very severe land degradation, including the southern and eastern highlands, the Lake Victoria Crescent, Southwestern rangelands and the eastern lowlands [7]. However, the adoption of agroforestry practices in Uganda is still in modest in scale [8], and this situation is known to exist in all tropical countries. Agroforestry technologies and innovations can make significant contributions towards addressing high levels of poverty and associated land degradation in Uganda [4].

For this to happen, however, there is need to promote agroforestry technologies and innovations that farmers can invest in and that in turn generate incomes and/or save them costs they incur. It is upon this background that this study aimed to develop an inventory of agroforestry practices and constraints among small-scale farmers in Butta sub-county, Manafwa district in Uganda.

2. MATERIALS AND METHODS

Butta sub-county is one of the sub-county in Manafwa district eastern Uganda. The sub-county has four parishes (Tooma Butta, Fuluma Butta, Busantsa and Butta). Butta sub-county is located in the eastern Region of Uganda, boardering the Sibanga in the east, Bupota in west, Bugobera in south and Buwagogo in north.

Table 1. Types of instruments, categories of respondents, sample selected and sampling techniques

Type of instrument	Category of respondents	Sample selected	Sampling Techniques
Interview Guide	Extension officers	3	Census
Questionnaire (Survey method)	Adopters	62	Stratified – Systematic sampling
Questionnaire (Survey method)	Non-adopters	185	Stratified – Systematic sampling
Total		250	

Source: Field Survey, (2015)

It lies between the longitudes of 34° 20 and 34° 23 east, and latitudes 1°0 to 1°0 North. It also lies on an average altitude of 1,800 meters above sea level.

The area experience bimodal type of rainfall with the highest in the first season of March to June and the second, which is normally light, in September to November. A short dry spell is between June/July while the December to March spell is longer with average rainfall of 1800 mm per annum. In general, there is no extreme temperature range; these conditions can be attributed to closeness to Mountain Elgon National Park.

A household survey was conducted in the three parishes of Manafwa district during April and May 2015. National Population and Housing Census Provisional Result 2014 showed that, Butta sub-county has a total population of 4,757 with total households of 1,002 (Census, 2014). Contact with the sub-county head quarter revealed that there are 120 agroforestry adapters and 3 Extension staff.

Butta sub-county was selected for the study because it was one of the two sub-counties (Namabya and Butta) chosen by ACIAR in collaboration with NaFORRI for agroforestry program. Butta sub-county has four parishes, which are Tooma Butta, Fuluma Butta, Busantsa and Butta. The sites were selected purposefully based on the agro-climatic condition. Ten villages out of sixteen were selected.

The study was conducted through a descriptive survey research in order to gather qualitative and quantitative data from the target population.

The study was conducted with the heads of household selected using a combination of multistage stratified random sampling and systematic random sampling (see above Table 1). The study population of this research involved two categories of respondents that are the household and extension officers from the sub-county. The household heads were further stratified into Adopters and Non-adopters. A sample of 247 (62 Adopters and 185 Non-adopters), small-scale farmers were used in the study. However, during data cleaning only 242 (60 Adopters and 182 Non-adopters), sample were valid for analysis.

A sample of 250 respondents was used as shown in Table 1 above. The respondents were systematically selected.

2.1 Data Analysis

The quantitative data collected from the household heads were analyzed using Statistical Package for Social Science (SPSS) version 20.0 and Microsoft office excel 2013. Descriptive analysis was conducted to estimate frequencies and percentages of the responses. Friedman test was conducted to identify the most critical constraints associated with agroforestry adoption.

3. RESULTS AND DISCUSSION

3.1 An Inventory of Agroforestry

The results of the inventory of Agroforestry practices in the three parishes of Butta sub-county, Manafwa district revealed that, the farmers are using a number of agroforestry practices. Five practices were identified and these range from Boundary marking, live fences, hedges, woodlots to Home gardens. The percentage numbers of farmers practicing each were shown in Table 2. Boundary marking and live fences were the most commonly practiced, 48.3% and 25.0% while woodlots have the least percentage of 5.0% farmers.

Boundary marking was highly ranked in all the three Parishes indicating its preference. It was characterized by planting trees a long boundary

Table 2. Agroforestry practices and constraints

Parameter	Frequency	Percent
Types of agroforestry practices		
Boundary marking	29	48.3
Live fences	15	25.0
Woodlots	3	5.0
Hedges	9	15
Home gardens	4	6.7
Values of trees on farm		
Mark boundary	61	59.2
Improve land fertility	43	41.7
Prevent gulley formation	34	33.0
Stop soil erosion	81	78.6
Improve soil moisture	56	54.4
Wind break service	56	54.4
Source of seedling		
Extension officers	3	5.0
Brought from private nurseries	36	60.0
Borrowed from friends	14	23.3
From on farm nurseries	7	11.7
Constraints		
Pests and Diseases	49	47.6
Shortage of labor	35	34.0
Shortage of land	34	33.0
Drought	35	34.0
Fire	45	43.7
Theft	18	17.5
Lack of seedlings	29	28.2

Source: household survey, (2015)
NB: N=60
Note that values of trees on farm constraint to tree planting are multiple responses and therefore could not add up to hundred

of two different farms. It is an important practice for marking property rights. Likewise, the practice helps the farmers by providing them with poles, timber and fuel wood. The trees also act as windbreakers, which reduce the effect of strong winds that could have damaged the crops. Most farmers also appreciated the fact that the trees save them the costs of buying barbed wires and poles for demarcating their farms. Tree species mostly observed for use in this practice included, *Sema spetabilis* (cassia). *Eucalyptus sp.*, *Ficus sp., sesbania sesban,* and *Azadirachta indica*.

These results agree with the findings of [9], who observed that in small scale farming areas, boundary planting reduces wind speed and that, trees on boundary which was regularly pollarded can meet most of a family's need for firewood while ensuring a properly demarcated boundary.

[10] Indicated that the most frequent species used in Agroforestry in Nyanza, Rwanda were *Grevillea robusta* and those belonging to the genus Eucalyptus. He noted that it is multipurpose and a good source of energy and it coppices readily and almost indefinitely.

Live fences were the second highest adopted practice by farmers in the study area. The highest (31.4%) percent was recorded in Butta and the least (12.1%) in Fuluma Butta. The trees were planted around homesteads and were mainly composed of indigenous trees used as medicine for households and livestock. Live fences control the movement of animals and people. Besides, their main function, trees used in live fences often provide fuel wood, fodder, food and act as windbreakers or enrich the soil depending on the species used. Common species used include, *Citrus limon fruit, Psidium Guajava, Dovyalis Caffra, Ficus sp., Jatropha sp., and Erthrina sp.*

A study elsewhere by [11] confirm the use of a mixture of *Citrus limon* and *Eucalyptus sp.* Leaves and *Psidium Guajava* leaves as

treatment for flu and fever was found to be widespread in Nhema communal area.

Hedge was the third highest adopted practice by farmers in the study area. Like boundary marking, hedges are trees and shrubs planted in thick bushes around farms and mainly play the role of fences and aesthetics. The tree species that were found commonly used in this practice include *Lantana camara, Dovyalis Caffra, Cupressus lusistanica* and *Psidium Guajava.* This practice helps in soil erosion control, protection of cultivated fields against destruction and fuel wood [3]. It was noted that, in Murang, a district in of Kenya, farmers planted trees on hedges for timber and as windbreakers, fuel wood and food [9].

Home garden as an Agroforestry practice was adopted across all the three sub-counties. Home gardens involved mostly fruit trees integrated with fodder crops, vegetables, beans and even maize on small gardens near the homestead. Fruit trees included *Persia Americana, Psidium Guajava, Carica papaya,* and *citrus sp.* Fodder trees included *sesbania sesban, Leucaena leucoecephala, Calliandra calothyrsus, Magnifera indica, bananas* and Napier grass.

The findings are also in line with [11,12] who noted the most commonly used plants for home garden include; food plants – *allium cepa, Moringa oleifera, vigna unguiculata, and zea mays; fruit trees – Citrus sinenseis,, Mangifera indica* and *Psidium Guajava*.

Woodlot though lowest ranked was adopted in the study area (Table 2). Wood lots comprise of sections of the farm set aside purposely for tree planting. Woodlots were most common (9.1%) in fuluma Butta Parish and least common (0.0%) in Tooma Butta. This practice was dominated by *Eucalyptus cassia, Cupressus lustanica* and *Grevillea robusta*. Woodlots were planted in poor land within the farm for rehabilitation of eroded areas. It was also valued for controlling soil erosion on sloping landscapes and as a source of household income.

3.2 Constraints Faced by Farmers in Adoption of Agroforestry Practices

This study revealed that small-scale farmers were facing various constraints that were aggregated into major categories associated with agroforestry. It was observed that agroforestry in a wide variety of forms have a great potentials in all the study areas. However, the respondents did not fully maximize the benefits of such agroforestry practices due to these constraints (Table 3).

The result revealed that the most significant constraint was Pest and diseases with mean rank 1.24 (Table 3). Majority of the respondents (47.6%) reported that there was occasional outbreak of pest and disease that attack trees in the area (Table 2). This support the findings by [13,14] who reported that, in Swat, Pakistan harboring of insects, pests and diseases were the major constraints to tree planting in the area. [15] also reported tree pest and diseases, bush burning and drought as a constraint to tree planting in the lower Kagera, Uganda. He also indicated that forests harbor wild animals that destroy crops.

The problem of fire outbreak came second with 1.32 mean rank. More than forty three percent (43.7%) of the respondents revealed that, fire from hills and bush burning during dry season destroy most of the trees they plant.

About the shortage of labor, 34.0% of the respondents reported being-faced with shortage of labor because most of their children attend boarding schools. Therefore, farm labor is most available only during holiday. However, according to Friedman test as indicated in table 3, this variable has the third lowest rank (1.51) at p=0.000. [13] reported that, the bigger the family sizes the more forested area. He argues that the size of the forested area can be related to the greater availability of labor for growing woody perennials and more requirements of woody perennials for fuel wood, fodder, timber and fruits for household utilization and to generate extra income to sustain their livelihoods.

Other constraints to Agroforestry adoption found in the study area were Drought, Shortage of land, and lack of seedlings and Theft with mean rank of 2.11, 2.41, 2.53 and 3.11 respectively. The respondents revealed that, though not always, they experience shortage or late rainfall due to change in climate that caused partial and temporal changes resulting in the dead of many seedlings. The Extension staff also confirmed this. [16] reported that shortage of land could be the major constraint in adopting Agroforestry practices. In his study, he revealed that about 68% of the community had problem of land shortage that resulted in hindering the development of Agroforestry practices in Oromia, Ethiopia.

Table 3. Statistical test of constraints faced by farmers using Friedman test

Constraint	Mean rank	Test statistics
Pests and diseases	1.24	N=60
Shortage of labor	1.51	Chi-Square = 41.453
Shortage of land	2.41	Df=6
Drought	2.11	Asymp. Sig. = 0.000
Fire	1.32	
Theft	3.11	
Lack of seedlings	2.53	

Significant difference (P<0.01)
Note that the total number of respondents was more than the actual number mentioned in the table above because the respondents mentioned more than one problem being faced

Wafuke [9], also in his study on Agroforestry adoption in Kenya concluded that small-scale farmers in Kenya were constrained by cost of buying seedlings and farm labor in the adoption of Agroforestry practices. [17] mentioned pests (termites), drought, lack of land, diseases (that attack mostly coffee and oranges), and lack of seeds and seedlings were the major factors that hindered Tree planting in the study area. Limited capital to buy planting materials, garden tools and chemicals for spraying, human and animal damage, limited labor, and poor propagation methods as well as government policies on tree harvesting were among factors that inhibit Agroforestry adoption [17]. Interview with the Extension staff also revealed that there is increase in tree seedlings theft in the area, which made many farmers reluctant in planting trees on their farms.

In general, the constraints have different negative effect on adoption of agroforestry practices as shown by the analysis where P-value (0.00), $P < 0.01$.

4. CONCLUSION AND RECOMMENDATIONS

There are variety of Agroforestry practices that have been adopted in the study area which range from boundary planting, live fences, hedges, home garden to woodlots. Boundary planting has been identified as the most commonly adopted agroforestry practice among the farmers in the study area followed by live fences. Agroforestry practice like woodlots that requires a portion of land to be sacrificed are not widely practiced.

This study also revealed that, pests and diseases that attack seedlings and even killed them before they matured posed a major treat to tree planting in the study area. Wives and children are the main farm labor providers, which means that labor is often available when the children are on holiday since most of them attend boarding Schools. Other identified constraints to tree planting in Butta sub-county include shortage of land, Drought, Fire and lack of seedlings.

It is recommended that, government should initiate the projects to build the capacity of the farmers through training and orientation workshops. This study also suggest that, there is need for loans to farmers to cater to their financial needs and similar study has to be conducted in other parts of the country in order to assess the extent of Agroforestry practices so as to guide the planners to plan further interventions to improve adoption and practice of agroforestry.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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