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MANAGEMENT OF SHEA PARKLANDS IN THE WEST AFRICAN SAVANNAH

Shu-aib Jakpa, S.[*], Lovett, J. C.[**]and Donkoh, S.A.[***]

[*] *Faculty of Agriculture, University for Development Studies, Tamale, Ghana.*
***Twente Centre for Studies in Technology and Sustainable Development, University of Twente; Postbus 217;7500 AE; Enschede, Netherlands*
[***] *Faculty of Agribusiness and Communication Sciences, University for Development Studies, Tamale, Ghan*

Corresponding Author: ssjakpa2020@gmail.com

Abstract
This research was conducted in Ghana to identify the strategies and practices used in managing shea trees. A multi-stage sampling design was used to select 540 farmers for the study. Descriptive statistics were used to analyze the relationships between socio-demographic factors and willingness to continue managing shea trees. Even though almost all the respondents expressed willingness to continue managing the shea trees, the most willing included the following: natives; those who purchased their lands; farmers with shea trees closer to their homes; those who owned their lands in addition to the shea trees and communities where the landlords or the community as a whole had authority over the lands and shea trees. The use of alternative sources of energy such as gas stoves, solar panels and locally-made stoves with high energy-use efficiency should be encouraged and made readily available and affordable to reduce dependence on shea trees as sources of energy for cooking and heating. Farmers should also be encouraged to grow fast-growing tree species such as Luecaena leucocephala, Senna siamea, Gliricidia sepium and Albizzia lebbeck as woodlots to serve as alternative sources of fuelwood and fodder. Furthermore, for their willingness to conserve the trees, farmers should be compensated for carbon credits generated from their shea parklands.

Keywords: Shea Trees, Management Practices, Willingness to Manage, Northern Ghana

Introduction

The shea tree is a multipurpose tree crop native to Sub-Saharan Africa (SSA). It is immensely valued for the oil that is produced from its nuts and used locally and worldwide in cosmetics, pharmaceutics and in chocolate formulations (Bup *et al.,* 2014). The shea tree is generally considered to be one of the most important tree species in the West African parklands. Its uses range from provision of income to environmental services in the semi-arid region (Teklehaimanot, 2004; Okullo *et al.,* 2004; Byakagaba *et al.,* 2011). The edible fruit pulp of the tree is consumed by both humans and animals while the butter is generally used in cooking food as well as in the pharmaceutical and confectionery industries for the production of useful products such as body creams, lotions and other body healthcare products (Lamien *et al.*, 2007). The tree serves as the bedrock on which most rural households in Northern Ghana depend for survival as it provides jobs for nearly 85 % of the people in that area.

Despite all these benefits, over the past decades the trees have been cut down for various uses, including clearing to create space for the cultivation of food crops as well as for fuelwood for domestic uses and for sale. These have resulted in drastic reductions in the shea tree population in Ghana. Most of the trees could have been conserved and managed alongside food crops, but insecure land and tree tenure serve as a disincentive for tenant farmers in particular to manage trees (McDermott & Schreckenberg, 2009). This has contributed to the declining numbers of shea trees in Ghana. As a result, a lot of concerns have been

expressed as to how to reverse these worrying trends as the population of shea trees have significantly dwindled over the past decades. In view of this, in recent times there have increasingly been on-going studies and discussions on how to deal with these disturbing developments of decreasing shea tree populations (Okiror *et al*., 2012, Okullo *et al.,* 2012, Buyinza & Okullo, 2015). One of the identified promising panaceas lies in the conservation of the trees through farm management practices (Lovett & Haq, 2000; Takimoto *et al*., 2008; Okiror *et al*., 2012; Okullo *et al.,* 2012, Buyinza & Okullo, 2015).

The traditional management of shea parklands usually involves the use of farming strategies and practices to manage and conserve shea trees and these have been identified as the most effective way of tackling the problem of decreasing shea tree populations. During such management activities, mature trees are preserved in each cycle of land preparation for farming and constitute a major part of the indigenous farming system (Tabuti *et al.,* 2009). The trees profit from agronomic practices such as weeding and management of soil fertility carried out for annual crops (Masters *et al.*, 2004) and increase in growth and yield. Ultimately, these trickle down to improve the livelihoods of households and communities that manage the trees and in turn help to conserve trees (Bigombe Logo, 2004; Shu-aib Jakpa, 2016) since farmers are able to derive financial and other benefits from the trees. As there is scanty or no data on such management practices in shea-growing areas of Ghana, to the best of our knowledge, it is worth identifying the practices that households carry out to conserve shea trees. As such, this study was conducted to find out the strategies and practices used by farmers and their households in Ghana in conserving shea parklands.

This study was conducted to address the following research question:

How are lands acquired for managing shea and which practices are undertaken by farmers at the local community level to manage shea parklands in Ghana?

Methodology

Study Location and Land-Use Systems

The study was conducted in the shea-growing areas of Northern Ghana; the three northern savannah agro-ecological zones of Ghana. One region in each zone was selected for study. Thus, three regions, Upper East region (representing Sudan Savannah zone), Northern region (representing Guinea Savannah zone) and Brong-Ahafo region (representing the transitional Forest/Savannah zone) were selected for the research.

Data Collection

Sampling Techniques

The study was done at 2 levels; the local community and household levels. A total of 540 respondents were chosen using the multi-stage sampling technique. At the first stage (Regional level) purposive sampling technique was used to select the 3 regions within the ecological zones of shea-growing areas in Northern Ghana. The second stage (District level) involved using a simple random sampling technique to select 3 districts in each region. At the third stage (Community level), a simple random sampling technique was used to select 3 communities in each district. The fourth stage (Household level) of the sampling design entailed using a simple random sampling technique to select 30 households per community for interview. The fifth and final stage (Individual level) involved stratified sampling where 2 persons (a male and a female) were selected in each household. This was done to ensure fair gender representation as both men and women are known to be actively involved in the management and processing. Details of the sampling procedure are indicated in

Table 1. Key-informant interviews and personal observations were also used to gather some of the required information. The focus of the study was on land/tree tenure, land/tree ownership, management strategies and practices and conservation in the shea-growing areas of Ghana.

Table 1: Selection of Respondents Using the Multi-Stage Sampling Design for the Study

	Zone	*Region*	*District*	*Community*	*No. of Households*	*Respondents*	
						Male	*Female*
1	*Transitional savannah*	*Brong-Ahafo*	*Kintampo North*	*Kawampe*	*30*	*30*	*30*
2			*Tain*	*Old Longoro*	*30*	*30*	*30*
3			*Pru*	*Yeji*	*30*	*30*	*30*
4	*Guinea*	*Northern*	*East Gonja*	*Fuu*	*30*	*30*	*30*
5			*Tamale*	*Nyeshei*	*30*	*30*	*30*
6			*Kumbungu*	*Cheyohi*	*30*	*30*	*30*
7	*Sudan*	*Upper East*	*Kassena-Nakana East*	*Paga-Badunu*	*30*	*30*	*30*
8			*Kassena-Nakana West*	*Gia*	*30*	*30*	*30*
9			*Bolgatanga*	*Kulbia*	*30*	*30*	*30*
Total numbers of respondents					***270***	***270***	***270***
Overall total number of respondents selected for the study						***540***	

Data Analysis

The data obtained from the field were inputed and processed using Microsoft Excel and Statistical Package for Social Sciences (SPSS) programme. Pearson correlation and cross-tabulation were used to investigate the relationship between socio-demographic factors and willingness to continue managing shea trees. The analyzed data (results) were then presented in the form of tables, histograms, pie-charts and cumulative curves.

Results and Discussion

Socio-Economic Characteristics of Respondents

Of the 540 respondents (50 % males and 50 % females) selected for the study, about 17.6 % were youthful (below 30 years), while 1.7% were in the aged category (> 69 years) (Table 2).

About 92 % of the respondents were natives in their communities, while a little over 7 % were non-natives. All the respondents indicated that they have been residing in the communities for decades with only occasional short duration visits to other communities. Almost 93 % of the respondents were married, while the remaining 7 % were widowed, single or divorced.

Approximately 40 % of the respondents had a household size of 1 – 5; about 50 % had 5 – 9 people in their households, while approximately 9 % had a household size of more than 10. Majority (65 %) of the respondents were Muslims, while practitioners of the African Traditional Religion constituted 16 %. Almost 74 % of the respondents had never had any formal education while about 26 % had at least studied up to basic education level. The majority (77 %) of the respondents were peasant farmers while about 21% were traders. Approximately 62% had up to 4 ha of shea parkland farms and almost 38 % had more than 4 ha of shea farms (Table 3).

Table 2: Socio-Economic Characteristics of Respondents

Factor	**Sex**		**Total**	**Percentage**
	Male	***Female***		
Age (years)				
<30	25	70	95	17.59
30-49	149	151	300	55.56

50-69	91	45	136	25.19
>69	5	4	9	1.67
Native or non-native				
Native	253	247	500	92.59
Non-native	17	23	40	7.41
Marital status				
Married	261	241	502	92.96
Single	9	6	15	2.78
Widowed	0	17	17	3.15
Divorced	0	6	6	1.11
Religion				
Islam	174	178	352	65.19
Christianity	46	56	102	18.89
African Traditional Religion	50	36	86	15.93
Educational status				
None	192	206	398	73.70
Basic*	50	55	105	19.44
Secondary	16	2	18	3.33
Tertiary	1	2	3	0.56
Others**	11	5	16	2.97
Primary occupation				
Farming	262	153	415	76.85
Trading	5	113	118	21.85
Civil service	2	0	2	0.37
Teaching	1	0	1	0.19
Dress making	0	2	2	0.37
Hair dressing	0	2	2	0.37

Table 3: Household Size and Farm Size of Respondents

Household size				
1-5	109	-	109	40.37
6-10	136	-	136	50.37
>10	25	-	25	9.26
Farm size (ha)* **				
<3	65	-	65	24.07
3-4	103	-	103	38.15
>4	102	-	102	37.78

*According to the Ministry of Education (2012), Basic education or Universal Basic Education in Ghana is 11 years, made up of:

i. 2 years of Pre-primary school (nursery/kindergarten);
ii. 6 years of Primary School: Primary 1 to Primary 6
iii. 3 years of Junior High School.

**"Others" refers to other forms of education such as Non-formal education, Arabic/Islamic education, etc.

*** Traditionally, women do not necessarily own land in the study area. The lands they farm are in the name of male members of their families (such as their husbands, family heads, clan heads, big brothers, etc).

Land and Tree Tenure

The results (Table 4) show that almost 98 % of the respondents own[1] the farmlands that they were working on together with the shea trees growing on them and had authority over their use while the remaining 2 % did not own their farmlands. About 81 % of the farmers explained that they inherited the farmlands together with the shea trees while 16.30 %, 1.48% and 0.74 % indicated that they acquired the lands through gift, renting and outright purchase respectively. The high level of land ownership appears to be a reflection of the existing arrangement where parents usually pass on their properties to the children. Almost 61 % indicated that they had authority and uses over the land they were working on, while about 21 % said the chief of the community possessed the authority[2] on the affairs of the farmlands they were working on.

Table 4: Land and Shea Tree Tenure in Ghana

Factor	Number		Total	Percentage
	Male	*Female*		
Ownership of land and trees				
Yes	264		264	97.78
No	6		6	2.22
How land was acquired				
Inherited	220	-	220	81.48
Gift	44	-	44	16.30
Renting	4	-	4	1.48
Purchased	2	-	2	0.74
Authority[3] over land				
Self	164	-	164	60.74
Chief	58	-	58	21.48
Clan	18	-	18	6.67
Traditional Chief Priest	16	-	16	5.93
Family	12	-	12	4.44
Landlord	2	-	2	0.74

Shea Tree Management Strategies

Approximately 92% of the repondents explained that they carried out management practices such as weeding and creation of firebelts around farms and trees and pruning branches of trees while almost 8 % indicated that they did not manage the trees. Of the number that managed their shea trees, about 90 % travelled up to 6 km from home to attend to trees. The remaining 10 % covered distances of more than 6 km from home to attend to trees on their farms. Although majoriy of the respondents were willing to combine the production of food crops with shea, they (about 97 %) were not prepared to cut down shea trees in order to cultivate food crops (Table 5).

[1] The respondents said they own the land (that belongs to their clans and families) and can sell it but with the consent of the heads of their clans, families and the chief of the community. Furthermore, although clans and families own lands and have authority over their use, the Chief protects the overall interest and welfare of his community and protects lands and other resources of the community against adverse effects such as deforestation, indiscriminate bush burning and other forms of environmental destruction.

[2] The Chief has authority over lands in his community. He serves as the custodian of lands for and on behalf of the people of his community.

[3] Authority here refers to "the power, right and control over land and its use"

Table 5: Farmers' Strategies for Managing Shea Trees

Factor	*Male*	*Female*	Total	Percentage
Do you manage the shea trees				
Yes	249	-	241	92.22
No	21	-	21	7.78
Distance of farm from home (km)				
<3	135	-	135	50.00
3-4	74	-	74	27.41
5-6	35	-	35	12.96
>6	26	-	26	9.63
Do you manage the shea trees				
Yes	264	-	264	97.78
No	6	-	6	2.22
If Yes, which management practice(s) do you carry out on shea trees?[4]				
Preferred cultivating only food crops on your farm?				
Yes	56	-	56	20.74
No	214	-	214	79.26
Do you intend to remove shea trees and cultivate food crops?				
Yes	9	-	9	3.33
No	261	-	261	96.67

The identified shea systems being practised in the study area were shea agroforestry; shea trees intercropped with food crops; shea parklands on fallow lands with other trees but dominated by shea trees; shea parklands dominated by other tree species and other forms of vegetation; shea home gardens, e.g. backyard gardens, vegetable/crop gardens, etc. and small pockets of shea trees within communities, e.g. by schools.

Results of the study revealed that almost all (> 90 %) of the surveyed households in the northern savannah agro-ecological zones appreciate how shea trees are being destroyed through activities such as logging and bush burning and thus do their best to deliberately raise and protect shea trees on farms by allowing natural regeneration, creation of fire-belts around farms and trees and weeding around shea trees alongside other crops during cultivation. They also try discouraging other people from felling the trees and at the same time encourage them to raise mounds around the bases of trees that have their root systems exposed.

The farmers explained that their efforts result in the protection of shea trees as well as in increasing the numbers of shea trees through natural regeneration.

[4] Respondents' answers to this question were analyzed and presented in Table 6

Table 6: Local Shea Management Practices

Management practice	Response	
	Frequency	*Percentage*
Creation of fire-belts	269	99.63
Preventing indiscriminate tree felling	268	99.10
Managing young trees for effective regeneration	263	97.10
Raising mounds around exposed roots	247	91.48
Weeding around shea trees	245	90.74
Planting/using other tree species as substitutes for fuelwood	213	78.89
Pruning branches of trees	174	64.44
Planting of shea seedlings/sproutings on the farm	41	15.19
Control of insect pests and diseases	18	6.67
Manure application	11	4.07

They appealed for assistance in the form of financial support, farm inputs such as working tools and equipment as well as pesticides. Up to 80 % of the respondents indicated that they employed other management strategies such as planting and using other tree species as substitutes for fuelwood, pruning branches of shea trees, planting of shea seedlings/sproutings on farms, control of insect pests and diseases and manure application (Table 6).

Authority over the Land and the Shea Trees

Who has the authority in making decisions on the management of shea trees in communities in Ghana?

Men are regarded as heads of families in the communities and they have authority over land, farms and shea trees and make decisions on how to manage them. From the study, farmers and chiefs/other traditional leaders in the communities were identified as the main authorities and respectively formed 60 % and 20 % of the main decision makers in shea tree management within the sampled communities. Other identified decision makers were traditional chief priests (7 %), Clan heads (6 %), family heads (5 %) and landlords (2 %) (Figure 1).

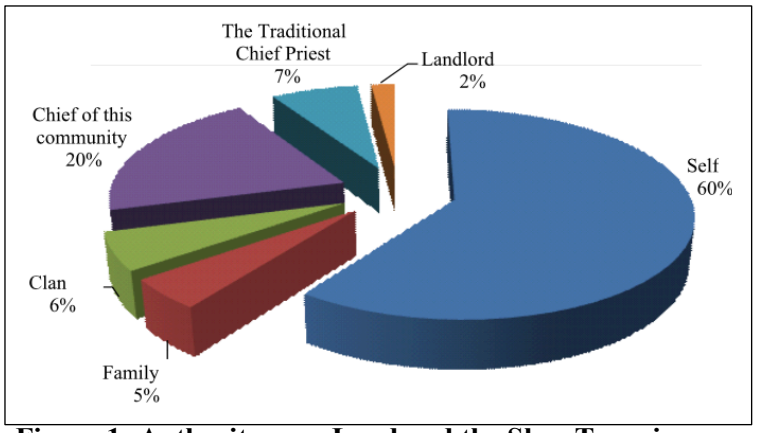

Figure 1: Authority over Land and the Shea Trees in Northern Ghana

A cross-tabulation analysis shows that respondents' continuous management of shea trees is significantly influenced by whether they are native in the village or non-native, mode of land acquisition, distance of farm from home, ownership of the farmland and shea trees, authority over land and shea trees and benefits from the shea trees (Table 7).

With regards to whether one is a native or a non-native, 92.7 % natives and 87.0 % non-natives respectively said they wanted to continue managing shea trees. Also, the results show that all the respondents who purchased their lands (100%) said they would continue to manage their shea trees.

Similarly, farmers with shea trees of less than 3 km from their homes constitute the highest percentage of farmers (97.7 %) among their category, who were willing to manage the trees. With regards to ownership of the land and the shea trees, willingness to protect the shea trees was highest in communities where the land and the shea trees were vested in the traditional chief priest (100%), landlord (100%) or the family (100%). However, willingness to protect the land and trees was highest in instances where the communities had oversight responsibility over the natural resources.

Table 7: Cross-Tabulation of Indigenousness, How Land was Acquired, Distance of Farmland, Ownership and Authority over the Land, Owned against Respondents' Willingness to Manage Shea Trees (N = 270)

	Willingness to continue managing shea trees					
	Willing		Not willing		Total	
Variable	**Freq.**	**%**	**Freq.**	**%**	**Freq**	**%**
Nativity						
Native	229	92.7	18	7.3	247	100.0
Non-native	20	87.0	3	13.0	23	100.0
How farmland was acquired						
Purchased	46	100.0	0	0.0	46	100.0
Inherited	153	91.6	14	8.4	167	100.0
Gifted	39	86.7	6	13.3	45	100.0
Rented	11	91.7	1	8.3	12	100.0
Distance of farm from home						
<3km	143	97.9	3	2.1	146	100.0
3-4km	59	81.9	13	18.1	72	100.0
5-6km	26	89.7	3	10.3	29	100.0
>6km	21	91.3	2	8.7	23	100.0
Who owns the land with the shea trees						
Myself	158	98.1	3	1.9	161	100.0
Family	22	100.0	0	0.0	22	100.0
Clan	21	91.3	2	8.7	23	100.0
Chief of this community	20	71.4	8	28.6	28	100.0
This community	14	66.7	7	33.3	21	100.0
Self & the chief	1	50.0	1	50.0	2	100.0
The Traditional Chief Priest	7	100.0	0	0.0	7	100.0

Family & Chief	4	100.0	0	0.0	4	100.0
Landlord	2	100.0	0	0.0	2	100.0
Who has authority over the shea trees						
Myself	159	98.1	3	1.9	162	100.0
Family	12	92.3	1	7.7	13	100.0
Clan	15	93.8	1	6.3	16	100.0
The Chief	40	72.7	15	27.3	55	100.0
The community	2	100.0	0	0.0	2	100.0
The Traditional Chief Priest	16	94.1	1	5.9	17	100.0
Landlord	5	100.0	0	0.0	5	100.0

Land Acquisition and Management of Shea

Almost all (98 %) the respondents indicated that they own the farmlands they were working on together with the shea trees growing on them, with only 2% indicating that they did not own the farmlands and the trees. Due to the fact that shea trees form an integral part of the lives and livelihoods of the local people (IOI Group, 2011), the trees are cherished and are therefore inherited from generation to generation. This was evident in the responses from majority of the respondents (81%) who inherited the trees from their parents or members of their clans. Being a tree species of high priority for African genetic resources (Teklehaimanot, 2004), traditional leaders in most communities consider shea trees as not only individual, family or clan property but as community property as well. Thus, although 60% of the farmers indicated that they had authority over shea trees on their farmlands, traditional leaders and chief priests played active roles in overseeing the management and conservation of the shea trees in their communities. Chiefs usually serve as the political heads of their communities while the chief priests basically function as the spiritual leaders and are responsible for the spiritual well-being of the people and all other resources in the communities.

The various shea systems (shea agroforestry, shea parklands and shea home gardens) were all managed in the study area with more than 90% of the respondents indicating that they raised and protected shea trees deliberately on their farms and fallowlands by allowing natural regeneration and observing the other management practices (Table 5). And if the seedlings are protected *from fire and grazing animals and properly taken care of through other suitable land management practices, the seedlings could grow into big and robust mature trees.*

One of the farmers in Fuu in the East Gonja District of the Northern Region, Yakubu Saaka said: *"We do our best to protect the shea trees because we derive a lot of benefits from them. It however seems our best is not enough because people continue to cut down the shea trees. We sometimes arrest such people and hand them over to the Chief or the police for punishment. Some of these people mostly hide and cut down the trees. We know it is poverty that compels them to cut down the trees to sell as fuelwood or use them to produce charcoal for sale. So we wish something could be done about this to stop people from cutting down the shea trees. We also need help in the form of financial support and farm tools and equipment to protect and manage the trees".*

Marthin Awuni, one of the farmers in Kulbia in the Bolgatanga Metropolis of the Upper East Region also said:

"Let me ask you, is it not strange that we conserve and protect the shea trees because a lot of them are occupying fertile farmlands which we use for cultivating food crops? And you know land is becoming scare these days. I hope we will get some compensation for our efforts for not removing some of the trees to cultivate our food crops. As for us, we will continue in our small way to protect and manage the trees because they are important to us".

Socio-Demographic and Management Factors Influencing Shea Conservation in Northern Ghana

Notwithstanding the fact that there are many constraints associated with the management of shea trees such as farmers' reliance on nature for the regeneration of the trees, felling of the trees to make way for cultivation of food crops and urban infrastructural development such as construction of roads and bridges, fuelwood and charcoal production for sale as well as for use in cooking and heating, almost all the farmers (95%) were willing to continue managing the shea trees.

Cross-tabulation of the factors indicated that majority (84.5%) of the natives were more willing to continue managing shea trees than non-natives. This could be as a result of the recognition of the shea trees as being of high priority for African genetic resources (Teklehaimanot, 2004) and economically valuable (Okullo *et al.,* 2004; Byakagaba *et al.,* 2011). As a result, to ensure that such trees are conserved to provide them with benefits, most farmers who are natives in their communities usually manage their trees, which significantly benefit from agronomic practices, such as weeding and management of soil fertility employed for annual crops (Masters *et al.*, 2004).

Farmers who inherited farmlands were more willing to continue managing shea trees owing probably to the fact that they considered the trees to be an integral and crucial part of their lives and livelihoods (IOI Group, 2011). Therefore, to preserve their cultural heritage, customary practices and traditions meant that they needed to manage the shea trees to continue surviving on their lands. In addition, most of the farmers who acquired their farms by inheritance said they have the spiritual belief that there are links between their ancestors and the properties (including the shea trees) they bequeathed to the current and succeeding generations. Therefore, apart from the shea trees providing several vital products (Teklehaimanot, 2004) and numerous benefits, the farmers believed that to continue appeasing their ancestors meant that they needed to manage the trees and also ensure that they conserved the trees for posterity as well.

With regards to cross-tabulation of willingness to continue managing the trees with distance of farmlands and trees from homes of farmers, it can be deduced that willingness to manage shea diminished with distance; meaning the closer (less than 3 km) the farm was to the farmer's home the more he was willing to manage the trees. Conversely, the further away (3 km or more) the farm was from his home the more the farmer was unwilling to manage the trees. This is obviously due to the additional challenge of covering distances of more than 6 km to provide protection for the trees (Lovett, 2004), apart from the numerous management constraints such as financial constraints and lack of working tools and planting materials, particularly with farmers from the less-endowed Northern Ghana (Lund, 2003).

On ownership of land and trees, farmers who personally owned their farms together with the shea trees were the most willing to continue managing the trees probably as a result of their multiple uses (Teklehaimanot, 2004) and economic value (Okullo *et al.,* 2004; Byakagaba *et al.,* 2011). It is a tree species of high priority for African genetic resources (Teklehaimanot, 2004) and the ripe fruits are eaten as food during periods of food scarcity (Lamien *et al.*, 2007). In addition, farmers who owned lands managed the trees so that they could use the presence of the trees to continue to lay claim to the ownership of their lands. Farmers who did not own the land on which they were farming or had the trees were unwilling to manage the trees most probably due to insecure land and tree tenure.

Decisions on willingness to continue managing shea trees were mostly made by farmers who had authority over their farmlands together with the shea trees growing on them. Similar to ownership, farmers who had authority over their farmlands could make independent decisions on issues related to the land and the trees and were the most willing to manage the trees since they valued the presence of the trees on their farmlands most. This is because trees are used as symbols of ownership and authority over land since the claim of ownership of trees is tied to the ownership of land and vice versa. The choice of trees as a claim of ownership, though symbolic, is the main reason for conserving shea trees in particular on farmlands; it is as a result of the tree providing the main edible oil for the people (Saul *et al*., 2003). It is a tree species of high priority for African genetic resources with multiple uses in most communities (Teklehaimanot, 2004) as well as generating income (Okullo *et al.,* 2004; Byakagaba *et al.,* 2011) due to its multi-purpose tree nature.

Conclusion and Recommendations

The research findings show that, despite the numerous constraints associated with the management of shea trees such as farmers' dependence on nature for the regeneration of the trees, cutting down of the trees for cultivation of food crops and urban infrastructural development, fuelwood and charcoal production for sale and for use in cooking and heating, most farmers continue to manage shea trees. These significantly helped to improve survival rates as well as growth and yields of the trees. Willingness to manage and conserve shea trees is significantly influenced by whether the farmers are natives or non-natives, how the land was acquired, distance of farm from home, who owns the farmland and the shea trees, who has authority over the land and the shea trees and benefits derived from the trees. Therefore, in seeking ways of conserving shea trees in the study area, these factors should be taken into consideration since they play crucial roles in determining the willingness of farmers to manage shea trees.

Alternative sources of energy such as gas stoves, solar panels and locally-made high-efficiency-energy stoves should be made readily available and affordable for use to cut down on the dependence of people on shea trees as sources of energy for cooking and heating. There is also the need to encourage farmers to grow fast-growing tree species such as *Luecaena leucocephala, Senna siamea, Gliricidia sepium and Albizzia lebbeck* as woodlots. The branches of these trees can be pruned for use as fuelwood as well as their leaves and succulent terminal branches fed to livestock as fodder. This will also help to minimize the dependence on shea for fuelwood and fodder. Most importantly, individual farmers, households and communities should be compensated by paying them for the carbon credits generated from their shea parklands as their willingness to conserve the shea trees, to a greater extent, depends on the benefits and incentives they will get. This is the most significant way of motivating the farmers to manage and conserve shea trees since they will receive cash rewards for their efforts.

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