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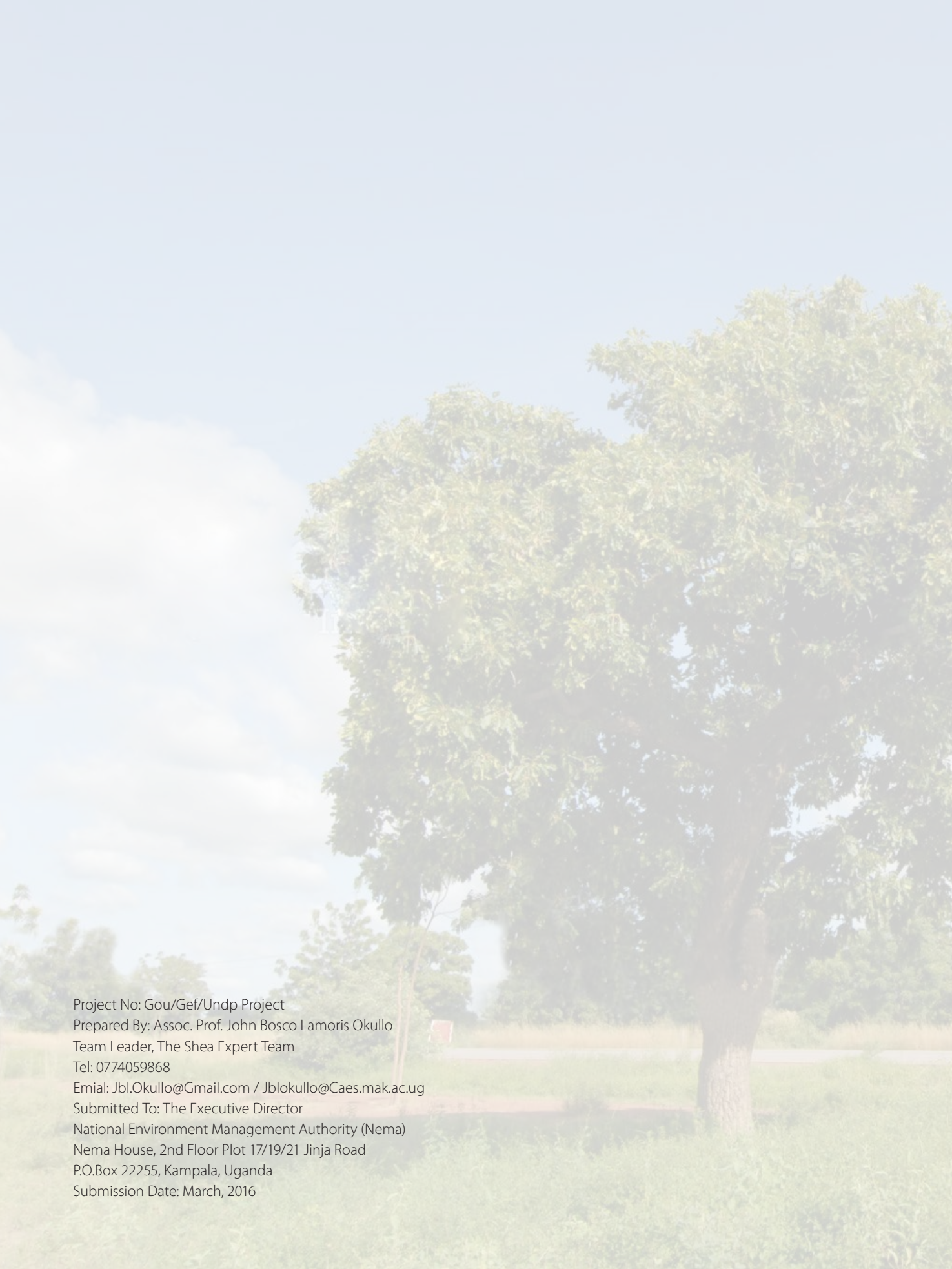
A Final Report For Inventory and Mapping of Shea Butter Trees in Abim, Agago, Kitgum and Otuke Districts On

POPULATION STRUCTURE AND CONSERVATION STATUS OF THE SHEA BUTTER TREES IN ABIM, AGAGO, KITGUM AND OTUKE DISTRICTS

Project: Conservation And Sustainable Use Of The Threatened Savannah Woodland In The Kidepo Critical Landscape In North Eastern Uganda

National Forestry Authority

UWA



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Foreword

Environmental degradation is a long time problem in Uganda and is threatening the productivity of the natural resource base on which development greatly depends. This has of recent been exacerbated by impacts of climate change which pose yet greater challenges on sustainability of the environment and natural resources, the basis for sustainable development in the country.

In 1994, Uganda completed formulation of a National Environment Management Policy for Uganda (NEMP), undertaken through a three-year comprehensive consultative process, the National Environment Action Planning process which culminated into the National Environment Action Plan (NEAP). Furthermore, this was in line with the Sustainable Development Agenda 21, which Uganda endorsed at the Earth Summit in Rio de Janeiro in 1992.

Since 1994, the NEAP for Uganda has been under implementation through the NEMP involving all players in environment management for Sustainable Development, including Government Ministries and Agencies, Development Partners, the Civil Society Organizations, the Private Sector, communities and individuals. After this long time of implementation, a number of gaps have emerged due to new challenges and opportunities, (new and emerging issues, the National Vision, the National Development Plan and Rio+20 commitments and outcomes), so much that the policy required a review to fill the gaps and integrate the new and emerging issues for effective policy implementation in line with the National Vision 2040 and the National Development Plan (NDP).

Therefore, the Government of Uganda with funding from the United Nations Development Programme (UNDP), through a project ***Improving Policies and Strategies for Sustainable Environment, Natural Resources and Climate Risk Management Project,*** evaluated and reviewed the NEMP (1994). The evaluation and review processes included the following key milestones:-

i) Synoptic policy study (quick scan evaluation) by Advocates Coalition for Development and Environment (ACODE) which required an in-depth evaluation and review of the policy; and

ii) The in-depth thematic policy evaluation through three consultancies that focused on the three thematic areas of sectoral, cross-sectoral and institutional framework objectives and strategies. The in-depth policy review processes included technical consultations within the Government Ministries, Departments and Agencies, civil society organizations and local governments; and

iii) Development of a new draft policy document that addresses the identified gaps, new and emerging issues, and the post-2015 Development Agenda (the new Sustainable Development Goals - SDGs).

Therefore, this is a synthesized report that comprises the consultancy reports from the review of the sectoral, cross-sectoral and institutional policy objectives and strategies of 1994. Notably the findings and recommendations from this report have the key inputs in the policy development phase that resulted into a new draft policy document (2014) for subsequent approval and implementation by the Government of Uganda.

Dr. Tom. O. Okurut
Executive Director
National Environment Management Authority,

October 2014

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Acknowledgement

We are very grateful to the Government of Uganda who through the United Nations Development Programme (UNDP), solicited financial support from the Global Environment Facility (GEF) for a project on the Conservation and Sustainable Use of the Threatened Savanna Woodland in the Kidepo Critical Landscape in North Eastern Uganda. Great appreciation is extended to the project implementation body; National Environment Management Authority (NEMA) which on behalf of the government in collaboration with Uganda Wildlife Authority (UWA) and relevant partners at the national and district level trusted the Shea Expert Team with the task of inventorying and mapping of Shea trees and wild life corridors in the districts of Kitgum, Agago, Abim and Otuke within the Kidepo Critical Landscape project area.

We are very much indebted to NEMA, UWA and NFA staffs for the guidance and assistance extended to us during the early stages of inception and those related to execution of the work until final report write up.

We would also like to acknowledge the enthusiasm and wonderful participation of all the Local Communities, Local Government, NGO and CBO Officials in all the four districts within the Kidepo Critical Landscape Project area. We are also highly indebted to all the experts who participated in teamwork or were consulted on all relevant issues related to the task in their respective capacities and for their individual contributions that led to the achievement of the tasks at hand.

We extend our sincere gratitude to all the Field Assistants who got involved in the data collection and collation for their respective contributions in the field preparations, community mobilization, field data collection, data cleaning/entry, data analyses and writing of various reports.

More thanks go to the Project Manager and NEMA Technical/Advisory Committee for providing support to the team right from the start to the final stages of preparation of this report. We extend special gratitude to Mr. Francis Ogwal (NEMA) and Mr. Aggrey Rwetsiba (UWA) for guiding the team to the field and helping them gain first hand understanding of the Kidepo Critical Landscape issues.

Further appreciation is extended to the various ethnic communities in the four districts visited for their passion in conservation of the Shea trees and their selflessness participation in all discussions whose results have contributed immensely to this report.

Lastly, we are very grateful to the GEF for funding this work and NEMA for availing us the opportunity to undertake this Shea Expert Team consultancy in four districts within the Kidepo Critical Landscape Project area.

Acronyms/Abbreviations

Executive Summary

Kidepo Critical Landscape (KCL) covers more than 10,700 km^2 of the north-eastern corner of Uganda. It consists of the districts of Kitgum, Agago, Pader, Otuke, Kabong, Kotido and Abim, the latter three forming part of the Karamoja region. The tree component of the vegetation of the KCL is dominated by shea butter trees. Generally, shea butter tree is an important tree species in the four districts and very many useful products such as butter oil, fruits, nuts, wood and charcoal can be obtained from it. The shea fruits are harvested from wild trees between April and September, mainly by women and children. Due to their importance, the shea fruits are awarded some protection within the districts in which they grow. Traditionally shea trees have been managed and conserved through pruning branches, integrating shea trees with other annual crops, weeding around the tree, cutting dead branches to allow new ones to sprout, sparing shea trees when opening agricultural land and protecting young shea seedling against fire and browsing animals. The parameters that farmers preferred from an ideal shea tree include those shea trees with high oil, highly producing trees with large and sweet fruits and high pulp content.

While the local people have positive attitudes towards planting and management of this particular tree species in the area due to the fact that nuts/oil products from the shea butter tree command an important position in the diet of the rural community in the area, excessive cutting of shea butter trees for charcoal and firewood has led to low density distribution of shea tree compared to other indigenous tree species in the area. An important component for the local community to promote conservation of the shea trees would be the development of organized Shea nut gatherers and training groups such as the Northern Uganda Shea Processors Association (NUSPA) which has the ability to supply high quality nuts, dry shea kernels and shea oil. Other than cutting shea trees for charcoal which fetches little money, diversification of shea products for various markets and community use would be more appropriate. This is so because the community had been managing and conserving shea trees on their respective lands before displacement. Therefore, all stakeholders should come up with legal approach towards promoting valuable conservation efforts for the shea trees.

All forms of institutions within the shea belt in Uganda should enforce bye-laws that promote conservation of shea and other associated indigenous tree species. The Training and sensitization of communities on appropriate management practices including assessment of shea fruit production offers an opportunity for producing high quality shea fruits for consumption and commercialization by the shea parkland communities and should be enforced. Such appropriate management practices include protection of shea trees from fire, weed control and removal of other trees that shade them to improving aeration, light penetration and reducing above ground/below ground competition. Controlled burning in August-September/early October and digging around the tree (spot weeding) can also be used to enhance regeneration and fruit production of shea trees.

Apart from the above, conservation education and awareness creation should be promoted targeting shea tree management practices such as pruning, leaf removal, water catchments and conservations on farms so as to improve shea fruit productivity and reduction in the rate of cutting down of shea trees for charcoal and timber. Tree improvement strategies geared towards producing Shea trees with high production/prolific fruiting, high pulp content, large fruits, soft fruits and early maturity through grafting and other tree propagation techniques should also be initiated and promoted among the shea parkland communities in Uganda.

Chapter 1: Introduction

1.1. Background

1.1.1 The Shea Tree *(Vitellaria paradoxa)*

Vitellaria paradoxa, the Shea butter tree, grows across a wide swath of Africa, from Senegal, Sudan, and Uganda to Ethiopia. Throughout the "Shea belt" the trees are highly valued by the local communities, not only for the economic and dietary value of the cooking-oil, but also for other products. The fruit pulp, bark, roots, and leaves are used in traditional medicines and the wood and charcoal are used for building and cooking. European explorers made first records of the Shea tree in 1728 and Mungo Park sent back the first samples to Europe in 1796. It was some 30 years after Park's expedition to West Africa that von Gartner in 1807 classified the tree within the family Sapotaceae, as *Vitellaria paradoxa.*

In 1865, Theodore Kotschy reclassified the West African tree as *Vitellaria butyrospermum* subsp. *parkii* and, at the same time, the East African subspecies, collected by the Reverend Knoblecher, was classified as *Vitellaria butyrospermum* subsp. *nilotica.* In 1962, Hepper reclassified the plant as B*utyrospermum paradoxum* subsp. *parkii* and B*utyrospermum paradoxum* subsp. *nilotica.* Most recently, Hall and Hindle (1995) reclassified the tree as *Vitellaria paradoxa* subsp. paradoxa and *Vitellaria paradox*a subsp. *nilotica.*

In his journals, Park described the local trade in Shea products as a vibrant, inland commercial activity and since that time, colonial agricultural officers have made detailed notes of the local trade in Shea nuts, butter, oil, cake, and latex, and speculated on its export trade potential. Along with many other oil crops, samples were tested for fuel and food products. By the 1920s, a flourishing trade was developing between Africa and Europe where the butter was used in making vegetable margarine and candles. However, changing agricultural policies in Europe towards greater self-sufficiency and new product formulations led to a decline in demand for Shea. In many respects, Shea tree now falls into the "Cinderella" or underutilized crop category. Shea continues to be processed and traded in the dry savannah region as a source of cooking-oil but it is no longer a mainstream industrial product. Despite interest by governments and support from FAO expert panels in developing local industries based on Shea, few attempts have been made to domesticate the crop. Essentially, Shea remains a wild fruit that is seasonally gathered by local communities.

For industrial processors, Shea has been relegated to a low cost substitute product but, as with true Cinderella commodities, there is a glimmering interest from the high value niche markets for greater use of Shea. Currently, Shea is undergoing renewed demand from the high value cosmetics companies. For this market sector, the very facts that Shea remains a "wilderness crop", that it is produced naturally, that it has cultural and medicinal qualities, and is collected and processed by women's groups in remote rural areas, all combine to create a fashionable scenario for high profile cosmetics marketing.

1.2. Brief description of Kidepo Critical Landscape

Kidepo Critical Landscape (KCL) covers more than 10,700 km^2 of the north-eastern corner of Uganda (**Figure 1**). It consists of the districts of Kitgum, Agago, Pader, Otuke, Kaabong, Kotido and Abim, the latter three forming part of the Karamoja region.

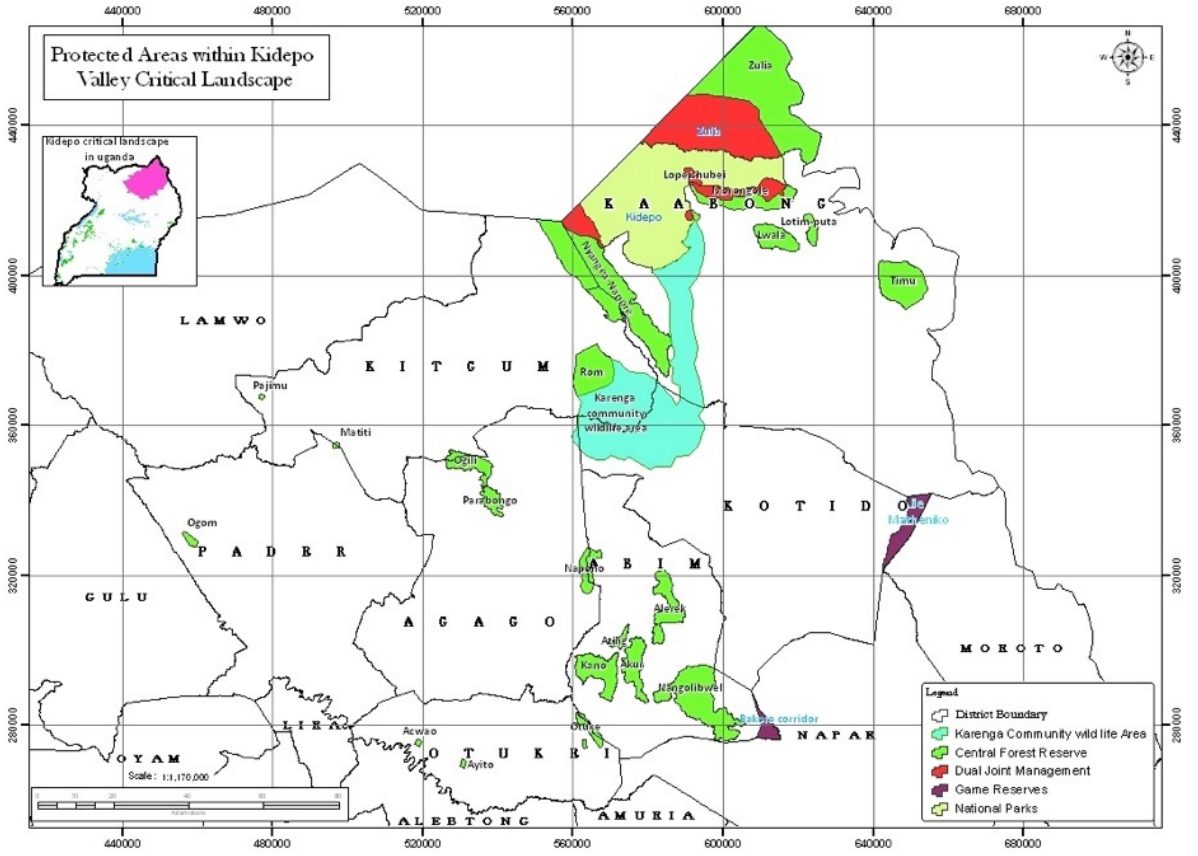

Figure 1: Kidepo critical landscape with its protected areas.

The main vegetation types are Sudanian savannah/Acacia-Commiphora bush lands and thickets in the east and tropical and sub-tropical grasslands, savannahs and scrublands in the west, with very small patches of tropical and subtropical moist broadleaf forests along the northern and north-eastern borders. The tree component of the vegetation of the KCL is dominated by shea trees (Vitellaria paradoxa). The shea tree is robust and survives in areas of 600-1400 mm rainfall per year and at altitudes of between 100-1200m.a.s.l.

Shea trees have significant ecological and economic potential for livelihood improvements; all parts of the tree can be used, including the fruit, roots, leaves and bark. The shea fruit is of particular importance due to the oil extracted from it, which has enormous nutritional and health benefits besides being a source of income. Within the KCL, shea fruits are harvested from wild trees between April and September, mainly by women and children.

Shea fruits are an important nutritional resource since they can be harvested during the annual 'famine season' when food stocks are at their lowest and the planting of new crops requires high labour input, and therefore high energy. Shea trees are therefore given some level of protection within the districts in which they grow. Living for 300 years or more, shea trees can act as carbon sinks.

1.3. Context of the Study and Scope of the Consultancy

1.3.1 Context of the Study

Biodiversity in the Kidepo Critical Landscape is now under threat from new settlements by former Internally Displaced Persons (IDPs) who have escalated the demand for fuel wood and use of forest land for farming and other income generating activities. Although the protected areas within the KCL provide the key vehicle for biodiversity conservation, management capacities and effectiveness in these Pas are weak and sub optimal. Unless the PA system is strengthened, there is a strong risk it will never recover its full potential integrity.

The dominant vegetation in the KCL that comprises of shea trees has not been spared the ravages of biodiversity degradation. Shea trees have suffered as a result of large-scale cutting for charcoal and this has in turn contributed to the degradation of the fragile savannah ecosystems, loss of wildlife corridors due to habitat destruction, and a decline in agricultural production.

Already the shea region is experiencing an increased frequency in dry spells, particularly in areas where there has been heavy destruction often trees. With increasing drought expected due to climate change, conservation of shea can benefit livelihoods when agriculture loses productivity and becomes an unviable source of income.

1.3.2 Scope of the Consultancy

The purpose of the consultancy was to conduct an inventory and mapping of the shea tree within the Kidepo Critical Landscape **(Figure 1)** so as to come up with a recommended basis for monitoring the shea tree populations and their habitats including promotion of appropriate management and conservation practices in the project area.

1.4. Objectives

The overall objective of the activity was to generate data/ information on the status of shea butter trees in the districts of Abim, Otuke, Agago and Kitgum which would form a basis for monitoring status and trends of shea trees and animal dispersal in the area.

1.5. Tasks Undertaken by the Shea Expert Team

The team undertook the following tasks:

a) Conducted inventory and mapping of shea butter trees in the districts of Abim, Agago, Otuke and Kitgum;

b) Reviewed all relevant documents related to the status of the shea butter trees in the selected districts;

c) In consultation with UWA, NFA, NEMA, WCS, districts and local authorities identified wildlife corridors/ dispersal blocks in the districts of Abim, Agago, Otuke and Kitgum;

d) Basing on the information in (b) and (c) above mapped the distribution of shea trees and wildlife corridors/ dispersal blocks in the districts of Abim, Agago, Otuke and Kitgum;

e) Documented threats and good practices that can enhance/promote the conservation and sustainable use of Shea trees and wildlife life outside protected areas in the landscape with a focus on Abim, Agago, Otuke and Kitgum districts.

Chapter 2: Methods

The study was divided into the following parts: document review, social survey, shea inventory, identification of wildlife dispersal blocks and mapping/remote sensing.

2.1. Document Review

Secondary data were gathered through reviews of existing data, in the reports of other organizations and libraries. All the available documents on the shea tree in the four project districts were reviewed to ensure that the baseline issues on the previous habitat and the shea tree inventory are comprehensive and up to date. A fresh review of existing information was also conducted to identify and compile detailed taxonomical data of the shea tree, their habitats, local uses/ products and habitat linkages to sites of strategic importance beyond the project area.

2.2. Social Survey

Sampling strategy involved random sampling and also a purposive sampling in combination with snow balling technique. Primary data were collected using a combination of one-to-one interviews, Focus Group Discussions (FGD) and observational methods. Household interviews were conducted using a structured questionnaire.

A short questionnaire (Appendix…) was developed and administered to selected respondents in the respective sampled villages, parishes and sub counties in each KCL district. Sub counties, parishes and villages were selected through a systematic random sampling procedure. Households were then stratified according to the different villages that make up the sampled parishes (Table 1), while groups of 8-10 people were organized for the FGDs as appropriate.

Efforts were made to solicit information on the roles of special interest groups such as the women, youths, cultural institutions, local governments and Community-Based Organizations (CBOs).

Stakeholder consultations and analyses were also undertaken with various organizations to identify and understand their roles, responsibilities and contributions to management of the shea tree resource. The need for conservation of the shea tree was assessed focusing on different institutions. Consultative meetings were organized with community groups, NGOs/CBOs and officials of the District Forest Service, NFA, Environment and Production Departments in the project districts.

2.3. Shea Tree Inventory and Mapping

2.3.1 Plot layout

The study area in each district was divided into 4km2 grid plots using the Hawth's tools, an add-in tool to the Arc GIS version 9.2 Software. Three sample plots were selected at the gridline intersection and their Universal Transverse Mercator (UTM) coordinates recorded using a Garmin12XL GPS Unit.

Thirty two (32) grid intersections were selected, each having 3 sample plots, making a total of 96 sample plots for the district shea tree inventory. The sample plots were located in the field using topographic maps and a GPS unit. Plots of 50m x 100m were established for the study within district.

Table 1: List of Sampled sub counties and parishes in the four KCL Districts

District	Sub-counties	Parishes	Villages
Abim	Abim	Kanu	Geregere
	Lokutei	Orwamuge	Tyen Opok
		Oporoth	Anyalima East
	Alerek	Koya	Olilim
		Otumpili	Otumpili North
District	**Sub-counties**	**Parishes**	**Villages**
Agago	Agago Trading Centre	Pampara	Pampara East
		Agago Central Agali	Labowor Okok
	Kotomor	Omat Wee	Omatowee
		Olyelo Widyel	Olyelo widyel
	Lukole	Otumpili	Otumpili
		Kiteny	Ajiki Lango
	Lapono	Amyel	Atinikica
		Hunting Area	Kulodyang
	Kalongo Trading Centre	Alupere	Alok-kiwinyo
		Kubour	Kubour Bungu
District	**Sub-counties**	**Parishes**	**Villages**
Kitgum	Kitgum Matidi	Lumule	Gore
		Paibony	Lakworojok
	Lagoro	Pawidi	Oguda
		Lakwor	Lakwor central
	Namokora	Pajwok	Dog Pem
		kalabong	Winyorac
	Mucwini	Akara	Twon Okun
		Pudo	Lakwele Okato
	Labongo-Akwang	Lamit	Labwor Omor
		Pajimo	Pajimo West
District	**Sub-counties**	**Parishes**	**Villages**
Otuke	Adwari	Omito	Amon Oneno
			Acan dyang
		Okee	Adyera konya
			Agweng
	Orum	Anyalima	Anyalima
		Atanggwata	Barokango
	Olilim	Gotojwang	Gotojwang
		AnepKide	Tegweng
	Okwang	Arwotngo	Alumeri
		Olwornguu	Amele

To get a clear correction factor, two or more transects were also randomly established in each of the selected sub counties (**Table 1 above**) in a district originating from any spot where shea trees are present. Sampling plots of 50 x 40 meters (0.2 ha) and subplots 20 m x 20 m (0.04 ha) and 10 m x 10 m (0.01 ha) were then set up for enumeration of mature trees, poles & saplings and shea juveniles respectively (Parent, 2000).

2.3.2 Tree Variables recorded

In each of the identified plots, all the shea trees occurring in the plot were enumerated indicating respective diameter at breast height (DBH) measured at 1.3m using a diameter tape. Root collar diameter (RCD) was also recorded for those encountered shea trees that were less than 1m in height using a Vernier caliper. For the shea trees that forked below 1.3m, each stem that had a DBH equal to or greater than 10cm was considered as an individual tree. Recordings of DBH were organized into diameter size classes with a class interval range of 5.5cm.

2.3.3 Mapping

All shea trees encountered were geo-referenced by a GPS receiver and recorded. Waypoints coordinates were also taken at the center of each plot using a GPS Receiver for onward overlay on the area digital map in GIS (Bolstad, 2005).

These GPS positions were used to develop appropriate maps of sightings/occurrence of shea trees in each district. The shea tree counts were entered in MS Excel as stems per hectare (ha) and analysed in ArcMap GIS software. This information was overlaid on the shea resource map using varying colours to show the aggregate shea densities in the project districts (Bolstad, 2005). Use was made of the previously marked points by the NFA Biomass team within the shea project districts.

2.3.4 Identification of wildlife corridors/dispersal blocks

The wildlife corridors/dispersal blocks were assessed focusing on views from different stakeholders/institutions. Consultative meetings were organized with officials of the District Forest Service, NFA, Environment and production Departments in the districts, CBOs and all key informants in order to identify the possible wildlife corridors/dispersal blocks within the project districts.

Lastly, a thorough ecological survey was conducted in these areas within the project area to elucidate the indicators of the fauna presence in them. GPS positions were taken and used to develop appropriate maps of sightings of wildlife corridors/dispersal blocks/sites of nature conservation importance (SCNI) in the project area.

Chapter 3: Population and Regeneration Status of the Shea Trees in Abim, Otuke, Agago and Kitgum Districts

3.1. Findings on the Review of Shea Resource Population in Uganda

Studies conducted on Shea across Africa indicate the major differences in the average densities of trees across the Shea belt (**Table 2**).

Table 2: Mean numbers of trees maintained on farmed parklands across Africa

Country	Shea tree/ha	All trees/ ha	Reference	Rainfall mm/yr
Benin	24	63	Schreckenberg (1966)	1300
Burkina Faso	22	27	Boffa (1995)	900
Ghana	21-24	29-61	Lovett and Haq (2000)	1100
Uganda	7	26	Nkuutu (2000)	1200

Source: D. Nkuutu et al. (unpublished).

Although Shea has been under investigation for commercial exploitation in Uganda since the 1930s, there has been no comprehensive study to determine the distribution of shea butter trees in Uganda. The best information comes from the COVOL-INCO research project which conducted a series of surveys to determine tree density by land use and tree age profiles in selected counties of greater Lira district. Nkuutu also conducted a more extensive, though rapid, reconnaissance surveys in the northern districts outside the COVOL project area, to estimate the approximate shea and other tree densities in the Ugandan Shea belt.

The detailed surveys conducted in Otuke County now Otuke district by Nkuutu et al. showed a mean of 32 trees/ha of various species (**Figure 2**).

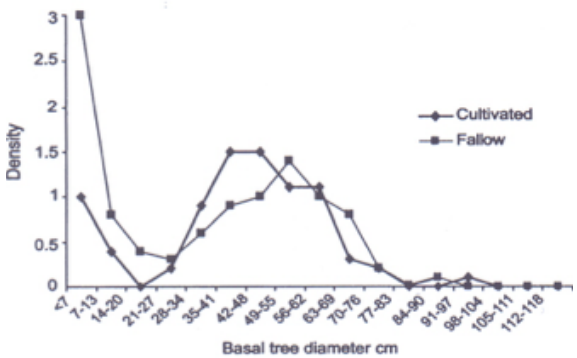

Figure 2: Density of Shea tree in fallows and cultivated land uses.

The tree population was made up from 72 recorded tree species. Within this agroecozone, the most common mature tree was Shea tree, at a density of 7 trees/ha, which accounted for 55% of the total estimated tree biomass. The survey also revealed that in the highest density locations, the numbers of Shea trees were up to 50 trees/ha. Excluding the wetland areas, the average density of Shea was approximately 9 trees/ha (**Table 3**).

Table 3: Distribution of tree density by land use

Land Use types	Mean density Shea tree/ha	Mean density other trees/ha
Cultivated	7.0 ± 4.7	19.3 ± 8.3
Fallow land	7.2 ± 2.8	33.8 ±17.6
Compound	12.0 ±12.2	22.4 ±27.1
Wetlands	0.3 ± 0.4	44.1 ±12.1
Average density	5.7 ± 2.	31.6 ± 8.4

3.2. Inventoried Shea tree Population and their Regeneration Status in the KCL Districts

A recent study of the general population of the shea trees in Abim, Agago, Kitgum and Otuke districts indicated that there were more shea trees (76trees/ha) in the forest reserve and 67trees/ha in grazing land compared to short fallows (51trees/ha), gardens (24trees/ha) and homesteads (14trees/ha) respectively (**Figure 3**).

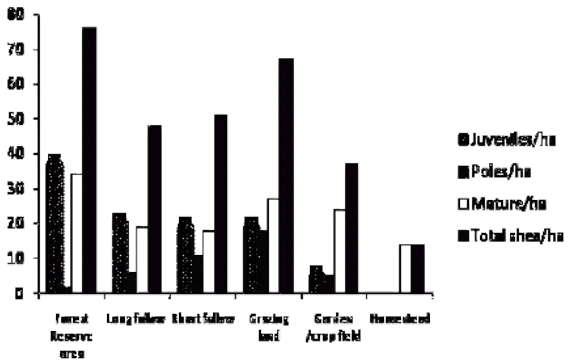

Figure 3: Average number of shea plants per ha in different land use types from 126 plots in Otuke, Kitgum, Abim, Agago, Kitgum and Kitgum Districts

The results also showed that economic activity and land use types also had influence on the distribution of shea trees under different land uses. While more shea mature trees (10 to 14/ha) were encountered on lands under long fallows in Kitgum and Agago districts, more saplings (34 shea trees/ha) were encountered in Otuke compared to other districts in this study.

3.3. Population status and density distribution map of the shea tree in the four districts of Abim, Agago, Kitgum and Otuke in Northern Uganda

3.3.1 Population status of the shea trees in Abim, Agago, Kitgum and Otuke Districts

The computation from all the inventories carried out in Abim, Agago, Kitgum and Otuke districts indicated that there were more mature shea trees followed by shea juveniles and lastly the saplings/poles in all the four districts (**Figure 4**).

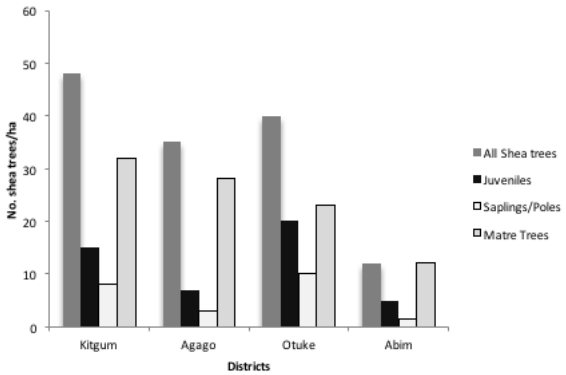

Figure 4: Density of all categories of shea trees in Abim, Agago, Kitgum and Otuke Districts

In particular, more shea trees were encountered in Kitgum district followed by Agago, Otuke, and Abim districts respectively. There were more juvenile shea trees in Otuke followed by Kitgum, Agago and Abim districts. Otuke districts had more saplings/poles compared to Kitgum, Agago and Abim districts (**Figure 4**).

The computation of the shea tree population density per respective districts in this are presented in the figures 5, 6, 7, and 8. In all sites inventoried seedling density was high in sites that had been under fallow compared to those sites which had been under crop cultivation respectively. Generally *Shea tree* sapling density was very low in all the four project districts suggesting that the Shea tree population risks degradation (**Figures 5, 6, 7& 8**)

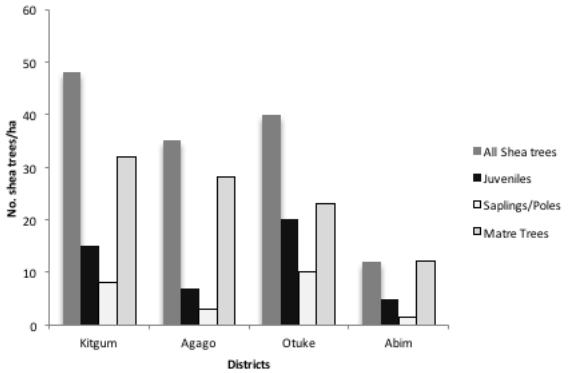

Figure 5: Population status of inventoried shea trees in Otuke District

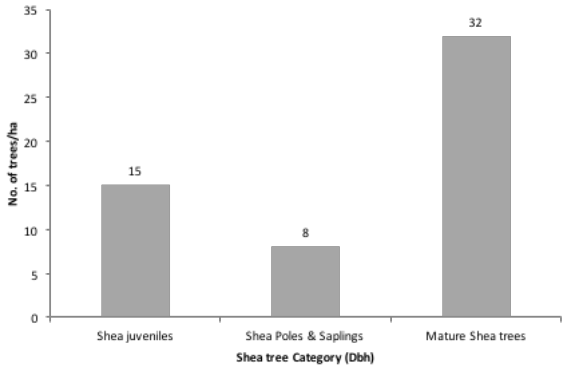

Figure 6: Population status of inventoried shea trees in Kitgum District

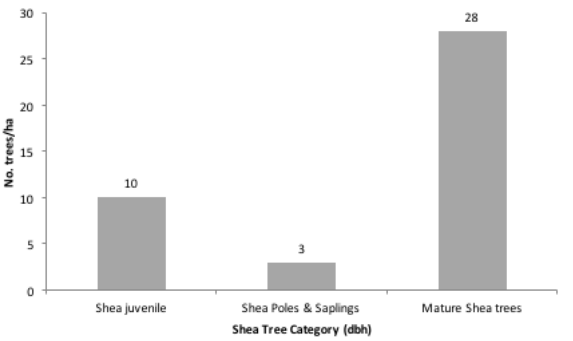

Figure 7: Population status of inventoried shea trees in Agago District

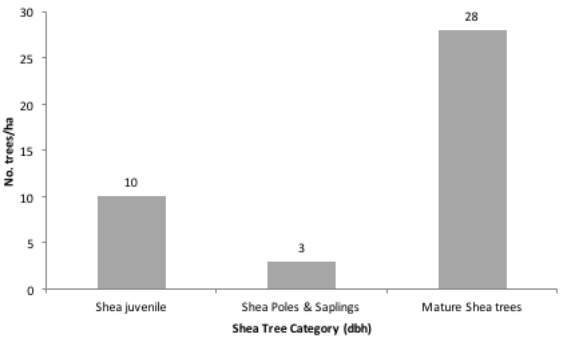

Figure 8: Population status of inventoried shea trees in Abim District

3.3.2 Density distribution map of the population status of the shea tree in Abim, Agago, Kitgum and Otuke Districts

Figures **9, 10, 11 and 12** are respective aggregated shea density distribution maps in Abim, Agago, Kitgum and Otuke districts.

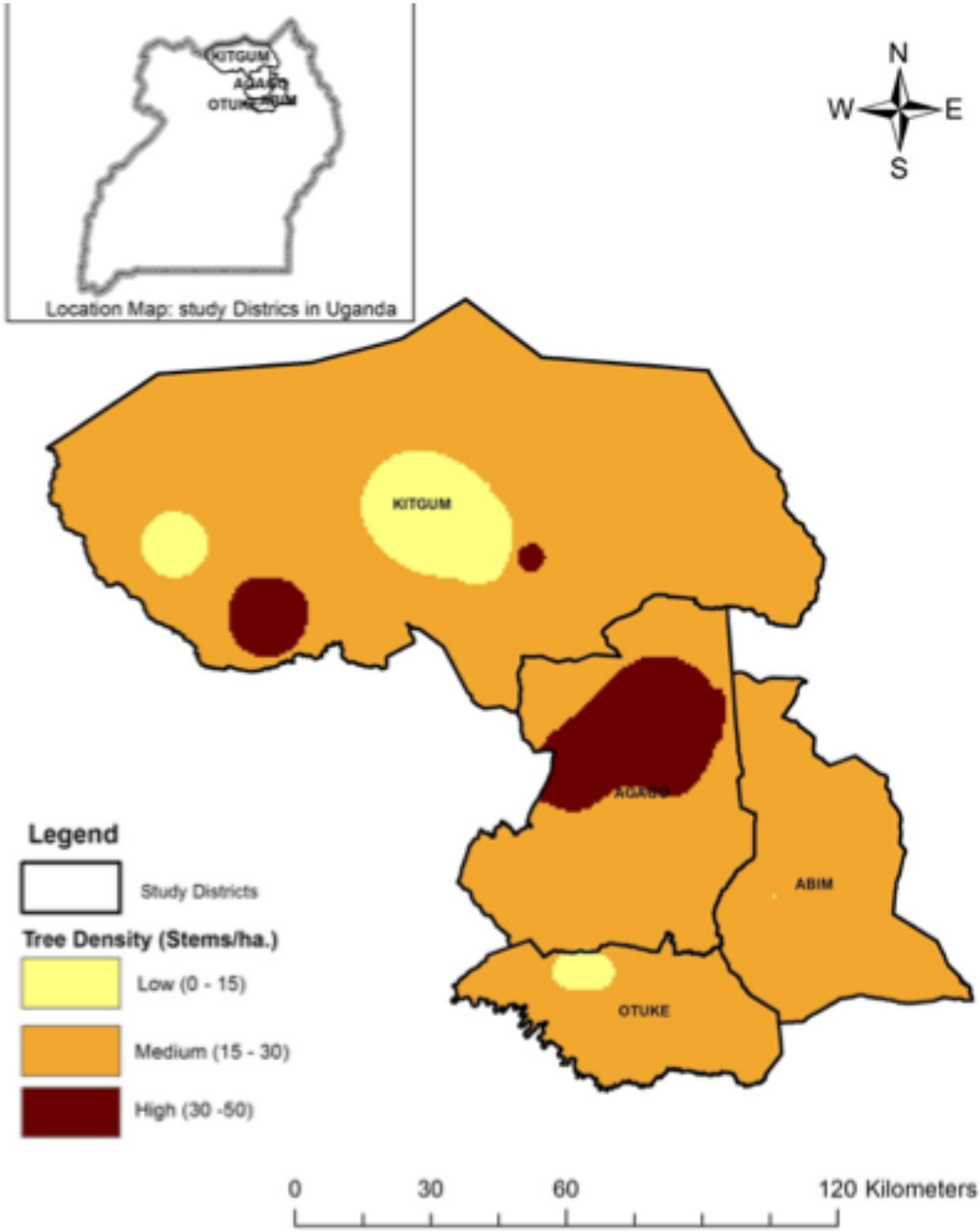

Figure 9: Density distribution map of mature shea trees (stems/ha) in the 4 Districts.

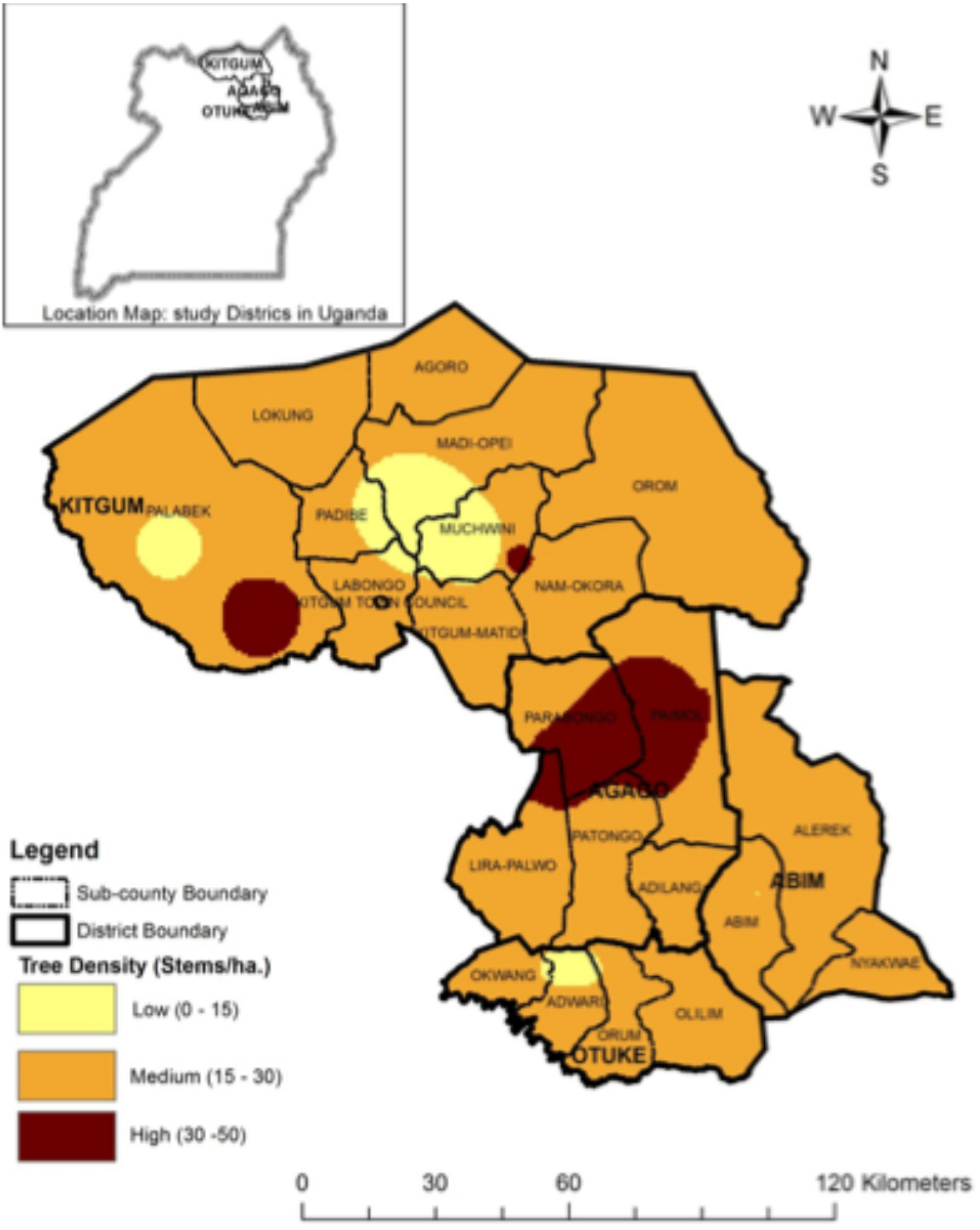

Figure 10: Density distribution map of mature shea trees (stems/ha) by sub county per districts.

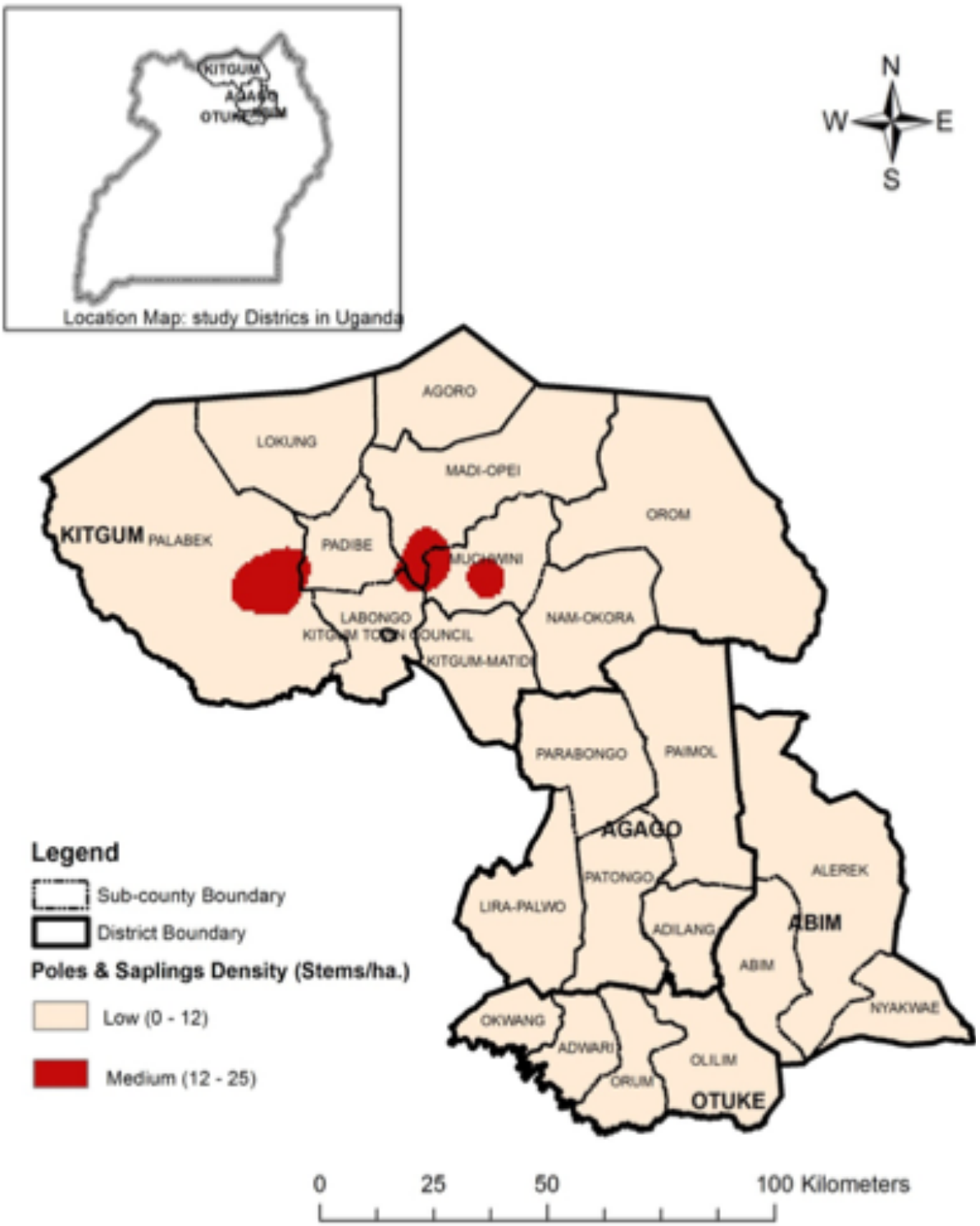

Figure 11: Density distribution map of shea poles (stems/ha) per District.

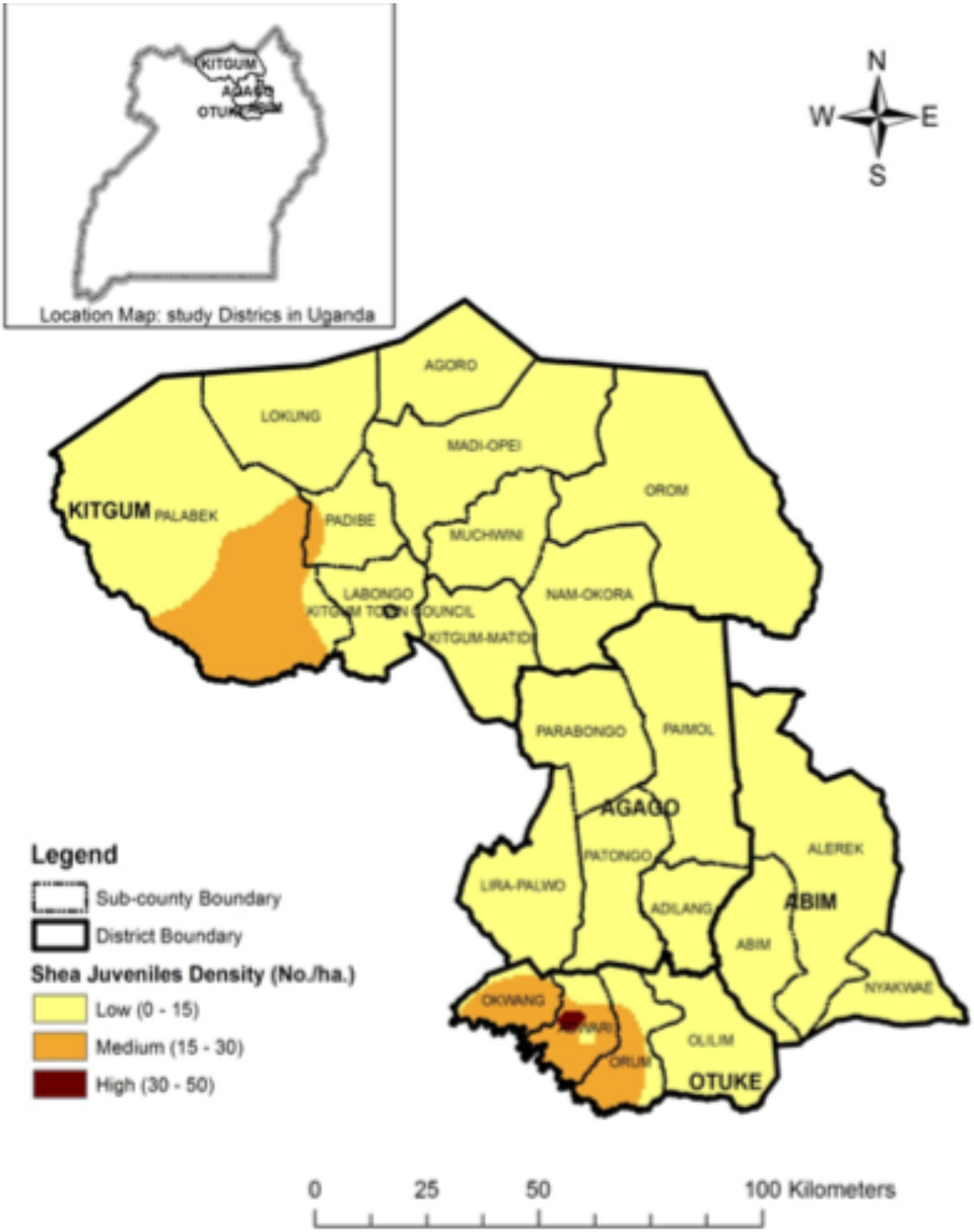

Figure 12: Density distribution map of shea juveniles (No. /ha) in the four KCL districts.

Chapter 4: Discussion on Population Structure and Density Distribution of Shea Tree in the Shea Parklands of, ABIM, Agago, Kitgum and Otuke Districts

4.1. Population Structure of Shea tree

Generally, the densities of mature Shea tree were the highest compared to that of saplings / poles and seedlings and coppices. Although the mature shea tree population was higher than both the poles / saplings and juveniles, the overall population was generally low given that the shea stands are dispersed in distinct clusters across the entire shea belt districts in KCL project area.

The size class distribution in each of the districts presented in the **Figures 5, 6, 7 and 8** all had close to inverse J-shaped size class distribution. While such kinds of distributions indicate better, regeneration the low density of saplings in all sites is an indication that very few of these regenerating individuals survive and get established into saplings/poles and other bigger size classes.

The low number of regenerating and shea juveniles could also be due to the fact that most of the fruits are collected for the production of shea oil or that anthropogenic activities might have also affected the regeneration process within these shea belt districts. Our observation during field inventories showed that recruitment of new individuals was poor in areas under cultivation suggesting that the value of young individuals in sustaining Shea tree population is not appreciated by the people/farmers in these districts. There is therefore a need for interventions that address the management of juvenile to guarantee a stable population of shea tress in these districts.

The trend showing lowest densities of sapling / poles was consistent across woodlands/forest reserve). The lowest sapling and pole population recorded in these woodlands/ forest reserves could be due to the vicious effect of wild fires from the thick fire materials (vegetation cover) that were observed in both cases (**Plate 1**).

Plate 1: Thick grass cover in the shea parklands is always a potential fire hazard that can wipe out the population of regeneration during the dry season; an insert from Otuke District- Arwotngo Parish).

Since the Shea tree has not been greatly integrated on farm, its wild nature (***Plate 1***) subjects the regenerating individuals to high risks of destruction by fires and juveniles are the most vulnerable. The presence of numerous burnt juveniles (coppices) that were sprouting supports this claim.

The large numbers of livestock grazed areas within the shea parklands as evidenced by the grazing trails and cow dung

indicates that regenerations of shea and other associated indigenous trees are also subjected to tissue destruction through trampling by animals. The implication of this is that the combined effects of wild fire and animal destruction can adversely reduce the population of shea and other regenerating individuals.

Furthermore, large crown sectional areas such as that of Shea tree which limit lights availability to under crops and affects agricultural crop performance (Plate 2) can also influence people's preference for indigenous tree species to retain on-farms. Such preference usually depends on particular tree desirable characteristics like minimal shading of agricultural crops and quick adaptability to the local environment (ICRAF, 2003).

Plate 2: Mature shea trees with large crowns in the shea parklands of North-eastern Uganda (insert from Agago District; Lukole Sub-county)

Since the farmer's key objective is maximization of crop yields, many people in the four districts may have eliminated regenerating shea and other trees to allow for perpetually increased crop yields. This and many other factors above may have accounted for the fewer numbers of regenerating shea trees compared to mature shea trees especially in cultivated fields within these KCL districts. According to Peters (1996) a tree population with an interrupted regeneration potential through excessive use pressures such as grazing, seeds or propagates (planting materials) collection is usually dominated by mature trees. Indeed the overall population structure of shea trees has been affected by the use pressures to the extent that there is lesser regeneration than mature trees.

The findings of this study and those done on Acacia parkland in Nakasongola by Agea (2006) further corroborate this observation. According to Agea (2006), abundances of regenerating Acacia Senegal were much less compared to that of mature individuals. This therefore suggests that all parklands tend to have similar resource use characteristics and environmental concerns. Although a higher regeneration of a given species would be ecologically essential in any habitat to enable it withstand environmental changes and use pressure, the trend reported in this study shows an uncertain future for the sustainability of shea tree resource use.

4.2. The Shea tree density distribution and zonal variation in Uganda

The density distribution with the highest average shea densities > 34 plants per ha recorded in Agago, Kitgum and Otuke districts (Figure 4) may be due to low human population; the two decades of LRA insurgency that significantly affected shea nuts collection and cutting of trees from the vast northern shea parkland and/or the conservation impetus provided by the lucrative local markets for shea tree primary products. These findings agree with that of Masters, (2002) which noted that shea tree regeneration in northern Uganda is responsive to the market incentives provided for the primary products. This might have been a motivation for farmers to protect shea tree seedlings when opening crop fields.

Analysis of the population structure by Lovett *et al.*(2001) also showed that the age profile of shea trees in Uganda was somewhat skewed with a gap in the size profile for trees in the size classes 7-25 cm diameter at the base of the tree. This finding suggests that the shea tree has been subject to selective age management, indicated by a high number of trees in the lower and higher age classes. This information also supports the view that there has been, in recent years, a systematic removal of shea trees to provide building materials and charcoal. Increased agricultural activities, road building, and urban spread have also led to systematic removal of shea trees.

While moderate shea tree populations of 15 to 34 shea plants per ha were also witnessed, other reduced average shea densities of 1 to 14 stems/ha encountered across Morulem Sub-county in Abim district and also other sub counties in these districts could be due to increasing demographic pressures on land for cultivation and the demand for other shea tree products such as timber and wood fuel (Plate 3).

Plate 3: Shea tree with branches heavily cut (pollarded) for various uses including charcoal and brick firing (insert from Otuke District, Orum Sub-county)

Field observations showed that despite the existence of other tree species within the shea parklands, the shea trees continue to be more preferred than other trees because of its superior timber, firewood and charcoal quality. Numerous shea stumps, severed trees, off-cuts from logs and earth charcoal kilns observed in the study area support this claim

4.3. Distribution of shea trees by land use in KCL Shea districts of Uganda

The major land use types documented within these shea districts were: garden or cultivated land, long fallow, short fallow, grazing land, protected or conservation areas, and homesteads or settlement land. The few Shea tree populations that were recorded within homesteads of formally internally displaced persons camps IDP (in the case of Otuke, Agago and Kitgum districts) and cultivated land is attributed to the multipurpose nature of the shea resource use and also preference for other fruit trees.

The 15 or more years required for Shea tree to start fruiting compared to *Mangifera indica, Citrus* species, *Heterophyllus artocarpus, Persea americana, Carica papaya* and other fruit trees that take shorter time to fruit reduces the shea tree competition for space on homesteads and on-farm. Due to less human activities and grazing intensities in fallows, large quantities of seeds that remain on the ground can germinate and continue to grow.

On the other hand, zero densities of the shea seedlings and coppices (juveniles) observed within some homesteads could probably be due to the demand for the nuts required for shea oil processing. Absence of poles and saplings on most homesteads also extended to grazing, short fallows, long fallows and conservation lands. As thick grass and other combustible bushes can increase the risks and intensities of the wild fires, annual fires could be the critical factor determining the survival of shea seedlings and existence of low populations of the shea tree poles and saplings.

In this report, 'long fallow' land is taken to be purely uncultivated land for more than six years whereas 'short fallow' describes the land that is left uncultivated for three to five years. 'Garden' or farmed parkland is considered as land under crops or land which has been cultivated in the last two years. Long fallow land exhibited the most natural ecosystem state than the fallow. They both registered more stable average total populations of all the three size classes: the juveniles, poles / saplings and the mature shea plants.

Long fallows had 48 plants per ha while short fallows had 51 shea plants per ha. This narrow difference in shea densities between long and short fallows could be attributed to reduction of wild fires due to limited vegetation in the short fallows. It could also be due to the absence or presence of limited utilization pressures exerted on both land; making the land to be in a state of recovery towards a natural ecosystem.

Grazing had little effect on shea densities compared to other land uses. Grazing land had the second highest total population average of 67 shea plants / ha after conservation areas. Although grazing activities can compact soil and destroy vegetation through trampling and tissue destruction, the population of all shea size classes were stable. The stable shea size class population implies that there is high rate of regeneration and growth.

Since cow dung can increase soil organic matter content, it could be possible that it can also enhance survival and growth of regenerating shea trees. Furthermore, reduction of grass cover due to grazing can reduce the risks and intensities of annual wild fires that are detrimental to the survival of shea tree regenerations. A stable population of shea trees was also therefore found where animals are grazed (**Plate 4**).

Plate 4: Regenerations of Shea treetrees in grazing land within the shea parkland of Agago district

The lowest total shea densities were observed on homesteads (average of 14 plants per ha) followed by cultivated land or gardens (37 plants/ha). These populations consisted of mainly mature individuals with 0% regeneration (juveniles, poles and saplings) present on homesteads and 12.3% on gardens respectively. The zero density of regeneration on homesteads may be attributed to total nuts collection for shea butter oil whereas the 12.3% regenerations on farm could be due to partial nuts collection and farmers' preference for the under-crops.

Since only mature shea trees are mainly left on farm (for fruits and nuts) the total number of shea (Shea tree) plants was relatively low. These findings also agree with the study conducted in the West African shea zone (Boffa *et al.*, 1995; Schreckenberg, 1996) which indicated that regenerating shea individuals were abundant on fallows. Unlike in fallows, farmers usually clear most regenerating shea individuals to give space for agricultural crops in current crop fields.

Even if highest total shea densities were encountered in some areas within the respective districts, and is ecologically healthy for continuity and survival of the species in a natural habitat, the steep decline in the numbers of poles and saplings encountered in other areas is not good for the shea tree population's viability.

It is probable that annual wild fires from the thick grass cover could have been a major threat to the survival of shea seedlings. In such cases, fewer shea seedlings survive and grow to sapling and poles stages than in other land uses.

Furthermore, field observations and inventory results show that gardens and other cultivated land had higher numbers of mature trees than regeneration stages. Anthropogenic factors related to size class selection could be the reason for this pattern of shea plant distribution.

4.4. Declining number of the shea trees

Farmers were aware of the causes of the declining number of fruiting Shea trees in the wild. Most of them attributed this to charcoal burning, cutting trees for building poles, handicrafts, firewood, wildfires and senescence. According to Ogwal (2000), a number of young trees (saplings and seedlings) cannot reach maturity due to environmental stress factors like fires, indiscriminate cutting and clearing of land for cultivation.

Losses of younger shea trees could also be linked to changing land use practices, increased level of permanent arable farming and increased human population density and pressure (FAO 2003). These factors have also been reported to impact negatively through loss of ecosystem functions that favour growth and development of associated crops (Boffa, 1999 & Teklehaimanot, 2003).

Chapter 5: Identification and Mapping of Wildlife Corridors/Dispersal Blocks in, Abim, Agago, Kitgum and Otuke Districts

From meetings and consultations with the different stakeholders/institutions plus consultative meetings with officials from the District Forest Service, Environment and Production Departments in the districts, CBOs, UWA, NFA and relevant key informants, possible GPS were taken for wildlife corridors/dispersal blocks within the project districts (**Table 4**).

Table 4: GPS points of possible wildlife corridors/dispersal blocks within the project districts

Agago District					
Location No	**Sub-county**	**Parish**	**Village**	**Geographical Coordinates**	
				Northing	**Easting**
1	Lapono	Amyel	Atimikica	02 ° 55.479'	033 ° 28.783'
2	Lapono	Amyel	Atimikica	02 ° 55.578'	033 ° 29.136'
3	Lokole	Otumpili	Lwala Central	02 ° 48.052'	033 ° 21.492'
4	Agago Town Council	Agago Central Agali	Olwornguu	02 ° 48.562'	033 ° 19.756'
Otuke District					
Location No	**Sub-county**	**Parish**	**Village**	**Geographical Coordinates**	
				Northing/Long	**Eastings/Lat**
1	Okwang	Arowtngo	Alumeri	0280890	0510943
2	Olilim	Gotojwang	gotojwang	0283347	0517500
3	Adwari	Okee	Adyerakonya	0286354	0536464
4	Adwati	Omito	Acandyang	0286334	0534183
Abim District					
Location No	**Sub-county**	**Parish**	**Village**	**Geographical Coordinates**	
				Northing/Long	**Eastings/Lat**
1	Lotukei	Oporoth	Anyalima East	33.63940	2.71008
2	Lotukei	Oporoth	Anyalima East	33.63880	2.71208
3	Lotukei	Oporoth	Anyalima East	33.63820	2.71392
4	Abim	Kanu	Geregere	0290960	0536464
5	Alerek	Otumpili	Outmpili North	0288921	0530190
6	Alerek	Koya	Olilim	0293238	0533168

Kitgum District					
Location No	Sub-county	Parish	Village	Geographical Coordinates	
				Northing/Long	Eastings/Lat
1	Namokora	Pagwok	Dog Pem	05 64308	036 7248
2	Mucwini	Pudo	Lakwele Okato	05 69427	036 8457
3	Kitgum Matidi	Paibony	Lakworojok	05 61196	036 6095
4	Labongo Akwang	Lamit	Labwor Omor	05 55085	040 6527
5	Lagoro	Lakwor	Lakwor Central	05 54454	040 7646

These GPS points and others taken on the various transects have been used to develop appropriate maps of sightings of wildlife corridors/dispersal blocks/sites of nature conservation importance (SCNI) in the project area (**Figures 13 & 14**).

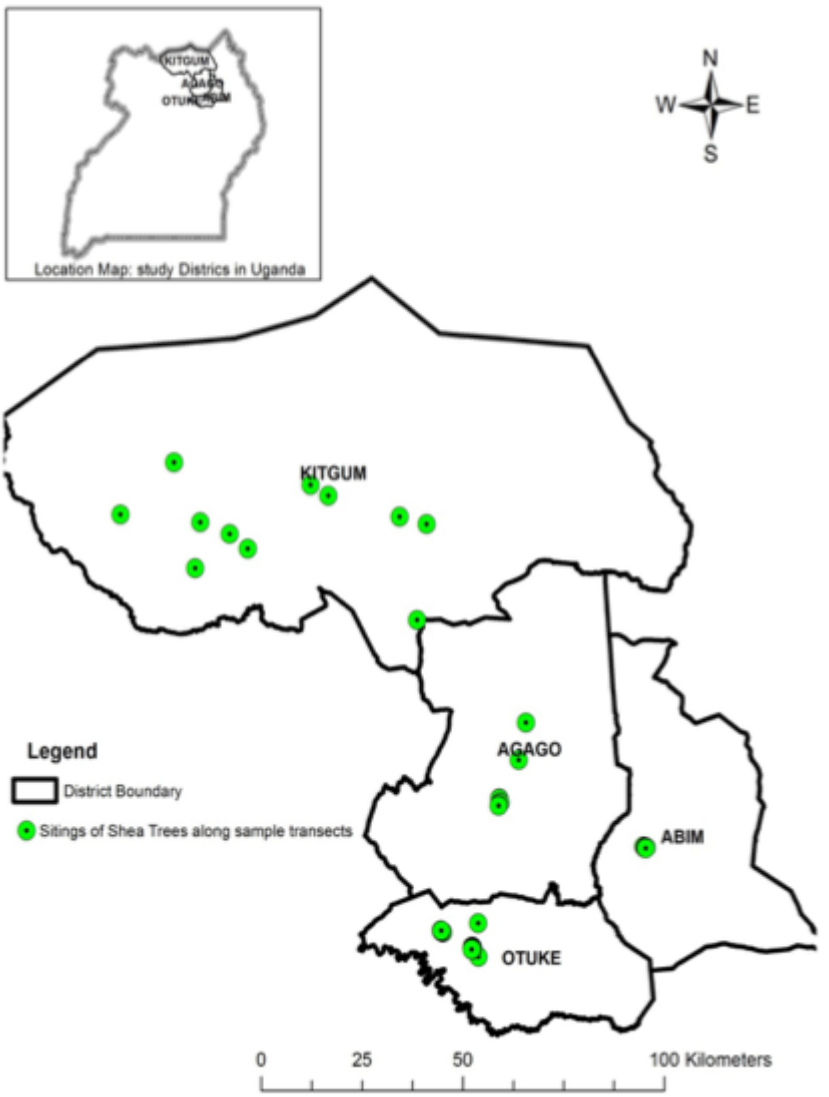

Figure 13: Shea trees sighted in the wildlife corridors/dispersal blocks/Sites of Nature Conservation Importance (SCNI) in Abim, Agago, Kitgum and Otuke Districts.

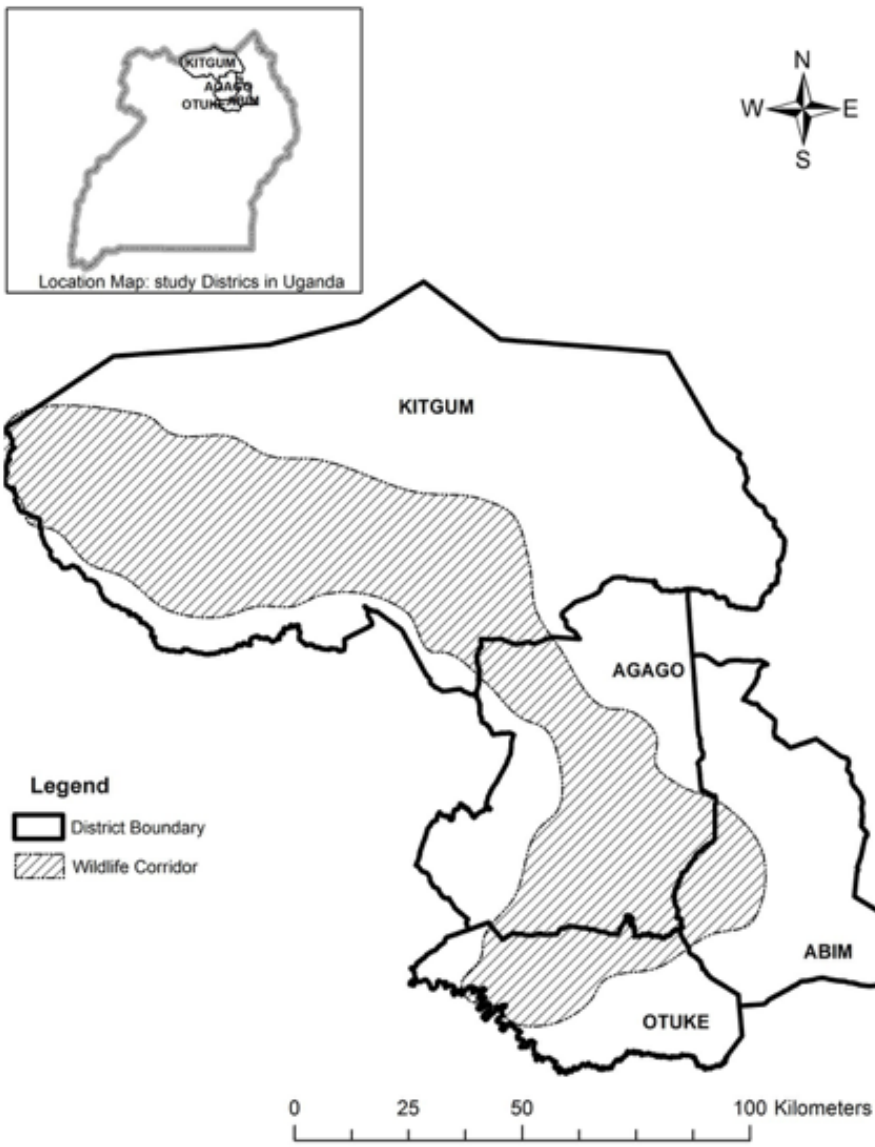

Figure 14: Demarcation map of Wildlife corridors/dispersal blocks/Sites of Nature Conservation Importance (SCNI) in Abim, Agago, Kitgum and Otuke Districts.

Chapter 6: Incorporation of Reviews on Threats/Constraints and Governance Issues Related to Conservation of the Shea Butter Trees in Uganda

The threats to conservation of the shea trees can be classified into two; threats to mature trees and threats to young plants/saplings. The most common threats to mature trees are charcoal burning, land tenure systems, human population pressure and insecurity of the population while threats to seedlings/saplings are bush fires, drought, human population pressure, animal herds and termites. These various factors have been described in details in the subsequent subsections.

6.1. Threat to Mature Shea Trees

6.1.1 Charcoal burning/trade and Unsustainable harvesting of Shea Trees in the four KCL districts

The shea trees are harvested for firewood function in the community and for cooking in boarding school is another threat to conservation of shea trees, cutting down trees for brick making, building poles and making of mortars.

The growing demand for charcoal especially in urban areas has seen a sharp rise in indiscriminate cutting down of trees in Abim, Agago, Kitgum, Otuke and other districts in northern Uganda. With low access to electricity, business oriented individuals have turned to harvesting shea trees to meet the growing demand.

The shea tree, being a hard wood tree species is believed by many to be a good source of energy/charcoal. It is for this particular reason that the Shea nut tree is being wantonly cut hence risking its degradation in these districts. In most parts of Abim, Agago, Kitgum and Otuke districts, the shea tree is almost depleted due to charcoal burning and clearing land for farming. Charcoal burning has become the main source of income for the region recovering from the over two decades of civil unrest and the brutal Lord's Resistance Army (LRA) rebel insurgency.

While the shea butter business is dominated by women, the charcoal business has both men and women in equal measure in Abim, Agago, Kitgum and Otuke districts. According to the Environment Officer, Otuke District (Mr. Ebong Boniface), the main reason for the continued cutting down of the Shea nut trees is the increased demand for charcoal, continued need for expansion of agricultural land and need for employment by mainly youth.

The number of people who are making a living by cutting and burning these trees for charcoal in Otuke District has been on a steady rise especially after the return of peace and security in the region. Most of the able-bodied men and women who want quick money are involved in this brisk business.

Before thorough operations were carried out to reduce or regulate charcoal burning, it was common to see slow moving trucks heaped with bags of charcoal, coming out of the district and heading towards the urban areas. The drivers of such trucks also tended to travel when the sun would be setting down or late in the night when they would be in know that Traffic Police Personnel and Environmental Police were not along the roads.

In an effort to curb charcoal burning, the Otuke Resident District Commissioner together with National Environment Authority (NEMA) and the District Local Government agreed to sensitize the community and also apprehend the culprits. For instance, in the recent past, several people allegedly found burning charcoals and cutting Shea nut trees in Otuke district, northern Uganda have been apprehended and detained at Otuke Police Station. Such operations were commanded by an Assistant commissioner of police aimed at protecting shea nut tree and other indigenous species in the district by stopping charcoal burning and unnecessary tree cutting.

After a survey found that the rate of tree depletion of shea and other indigenous trees in Otuke district was worrying, the Ministry of Water and Environment, National Forestry Authority (NFA) Kachung Sector and Otuke District Local Government agreed and started carrying out joint operations to ensure that cutting down of shea trees was reduced.

The joint operations by National Forestry Authority (NFA) Kachung Sector, Otuke District Local Government and National Environment Authority (NEMA) against those cutting shea trees for charcoal under the directive of Ministry of Water and Environment were aimed at regulating but not stopping cutting of shea and other trees."

Evidence related to involvement of Environmental Police in the fight to save environment within the shea belts in Otuke are indicated in the **Plates 5 to 8**.

Plate 5: Residents arrested by police over charcoal burning being taken to Otuke police, Northern Uganda.

Plate 6: Police officer and another person look.

Plate 7: Shea butter tree cut by residents

Plate 8: Police Officer looking at the heap of confiscated charcoal at Otuke district Headquarters.

In Abim District, just like in any other districts in Karamoja, formal employment is not common. Poorer households are actively engaged in charcoal making, firewood sales, and other forms of self-employment, such as honey and aloe vera sales. Famine is a common occurrence among local communities in Karamoja. It represents the different experiences and realities of the poverty, desperation and

a need that requires immediate, moderate to long-term solutions. At the immediate level, the need to leverage on the natural resources to survive past the biting pangs of famine is creating a nexus of threats to trees in Karamoja.

In general, the threats to in Karamoja include but are not limited to: the sale of firewood and charcoal which is usually is intensified in drought years. While firewood and charcoal sales occur throughout the year, in drought years, charcoal is also exported out of the region to other parts of Uganda. With increasing supplies of firewood and charcoal in drought years, prices decrease, leaving people with less of a return on their time investments. Charcoal and firewood sales are an important income source for women from all wealth groups, who may not have easy access to the cash from livestock sales (a transaction generally controlled by men).

Firewood, charcoal, building materials, gums, resins and extractives are also harvested from different tree species including the Shea trees within the sub-region. Apart from trees providing forage and browse to livestock during both dry and rainy season, the trees in the sub-region also act as wind breaks against the strong winds that emerge from the Turkana plains in Kenya; trees also help to control soil and water erosion. In places where trees have been cleared, soil erosion is strongly evident, developing into gullies.

The main issue of sustainability lies much more in the deforestation caused by firewood and charcoal sales, but this is also a common problem in much of rural Uganda. Indeed there is expanding charcoal and firewood supply belt eastward from adjacent Teso and Lango sub-regions to Karamoja particularly to the districts of Abim, Napak and Nakapiripirit.

Coupled with a destitute situation prevailing in the sub-region, the Karamojong have become easy bait from the profiteering businessmen/women based in the Mbale, Soroti and Lira towns as well as from growing business acumen from within the region. A bag of charcoal is purchased from the Karamojong at approximately UGX 15,000 (USD 6) and is retailed in Mbale or Kampala at approximately UGX 50,000 (USD 20). Therefore, the on-slot on trees in the region is fast, indiscriminate and competitive despite the presence of rules banning the production of charcoal.

To make matters worse, there is a serious breakdown in Karamojong traditional institutions. The Karamojong traditionally had a strong elders' council and elders' roles were defined in guiding the community. However, the advent of the gun changed the balance of power, the gun dictated who had power and control; as such young men became unruly leading to a shift from the traditional systems (Mirzeler andYoung, 2000). Even in the post disarmament period, the elders have never regained their position in the Karamojong society. This has meant that the guidance, rules and caveats that were always placed by the elders in conservation of natural resources are now little respected.

It is this divide and weakening of traditional institutions that is making the drive for charcoal burning easily acceptable and exercised among the youthful population. This is also indicative of the silent increase in individual interests as opposed to the traditional/communal interests that guided the pastoral way of life in the sub-region.

The loss of economic resilience in the Karamoja sub-region has triggered the destruction of the Shea trees for charcoal burning, which otherwise had been protected for its high economic value of the Shea butter oil. Despite lower revenues from charcoal burning than from Shea butter oil, people are usually forced to sacrifice long-term incomes to meet short-term needs for cash to meet their daily subsistence; thereby leading to a breakdown of resilience of the human-ecological system in this district.

Tree-cutting, both for firewood and charcoal-making, has been a common alternative source of income in Abim district and the Karamoja sub-region as a whole, particularly for women. However, it has also significantly contributed to deforestation in the region. Negative externalities of deforestation include limiting the ability to utilize tree products for alternative income, contributing to reduced soil fertility, decreased carbon stocks, and reduction of ground cover.

The increasing demand for charcoal from shea trees and the belief that charcoal from the shea tree is of higher quality than other trees (because it burns for a long time) have both threatened the survival of mature shea trees in the these districts. These have led to most shea trees being cut down for short time gains of charcoal trade and are also a major conservation threat. As most charcoal is sold to meet people basic needs, there is need to assess economic tradeoff between charcoal making and commercialization of shea butter fruits products in order to educate the community on conservation of the shea trees.

6.1.2 Unclear markets for the shea tree products

Poor marketing for shea tree products has been reported to be one of the current causes of destructive exploitation of the shea trees in Uganda (Ferris et al., 2004). Unsustainable utilization of shea trees for fire wood, making mortars,

building poles, charcoal and brick making has led to a reduction in its fruit production and exposure of the area to deforestation. Decline in productivity of the Shea tree is a growing concern and a threat to the shea industry.

Although on farm conservation of shea trees could increase both commercial and the industrial benefits of its products thereby improving income and food security, variability in fruit production of Shea trees is a great hindrance accelerated by human activities such as charcoal burning, grazing, bushfires, clearing land for agriculture and hunting (Masters and Puga, 1994).

Fruiting irregularities have also been linked to bush fires causing fast erosion of shea tree gene stock (Fleury, 1981). This is so because fire affects tree performance in terms of fruit production as trees under uncultivated communal lands are not protected. High premature fruit drop and low fruit retention is also a major factor contributing to low productivity of Shea tree in the shea parklands of Uganda (Okello, 2002).

Accordingly, if rainfall is low and unreliable, capturing the little that falls and making it available to crops could provide an effective way of improving farm productivity thereby reducing the farmers' vulnerability to agricultural drought. This means that investing in soil and water conservation through proper incorporation of agroforestry technologies would be very vital in overcoming climatic hazards and future climate change in the shea parklands in general. This is so because agroforestry entails useful attributes for conservation of biological diversity and improvement of ecosystems resilience.

6.1.3 Constraints to improving production of wild fruit trees

According to Akinnifessiet al. (2004a), farmers have consistently cited lack of planting materials as being the major constraint to indigenous wild fruit domestication. Others are long juvenile phase creating a considerable time gap between investment and income flows, lack of knowledge on seed treatment (e.g. scarification), and lack of knowledge on vegetative propagation as many indigenous trees have irregular and/or low seed production, lack of knowledge on reproductive biology, cultivation, seasonality and variation in fruit production.

Taylor (1983) also reported that lack of infrastructure in the rural areas can make access difficult and account for low volume of product, poor or variable quantity of products leading to irregular supply, poor handling and storage facilities and limited knowledge among the consumers.

6.1.4 Fire effects on fruit production of shea trees

The greatest damage by fire to the shea trees reported by the respondents was on fruits and flowers (95%), drying effects on tree branches (21%), leaf damages (17%) and destruction to the shea tree bark. Farmers' vast experiences on the devastating effects of fire on shea tree phenology are presented in **Table 5**.

Ninety percent of the respondents pointed out that fire was most damaging at early flowering (90%) at fruit set (18%) mid flowering (10%) and late flowering (3%). The most commonly reported local methods of controlling fire were by clearing fire lines/fire breaks, digging around the shea tree, slashing, early/controlled burning, and continuous grazing of animal (**Table 5**).

Table 5: Common methods of controlling wild or intentional fires

Methods	% response
Digging/clearing fire lines/breaks	47.8
Digging around trees(spot clearing)	45.7
Slashing around the shea trees	34.8
Early/controlled burning	32.6
Continuous grazing by animals	13.0
Avoiding setting bush fires	08.7

The most commonly reported vulnerable stages of the shea trees to fire damage are during fruit setting, start of flowering season, one month before flowering, before flowering bloom, at maturity and during fruit development. According to Okullo *et al.* (2004), the shea tree peak flowering late in the dry season allows most shea tree individuals to escape fire damage to reproductive structures and fire disruption of the reproductive process. Most damage to the shea trees occurs during early flowering because this is the period when people in the shea parklands set bush fires to stimulate fresh regrowth of grass for livestock or to clear the grass for hunting wild animals and this negatively affects fruiting of Shea trees.

Other factors that can affect regeneration and fruit production in shea trees are early on-set of dry season, strong winds; late on set of rainy season and prolonged dry spell. While much rain can influence fruit drop at fruit set, late on set of rainy season also causes reduction in fruiting. In addition prolonged dry spell and flooding can both promote premature drying of leaves and fruits while strong winds and early on-set of dry season can also promote premature fruit drop.

Subsequently, each extreme climatic phenomenon affects the shea tree at different phenological events. While high temperatures, can negatively affect the shea tree during early fruiting, strong winds on the other hand can affect the shea tree most at the flowering stage. It is worth noting that prolonged dry spell, strong winds and heavy rainfall are more destructive to shea trees at fruit set than any other stage.

6.1.5 Effects of weather variability on shea trees and fruit production

Farmers had experience in relating effects of weather variability (climatic phenomena) to shea tree fruit production. Seventy-five percent of the respondents reported that climatic factors can affect fruit production of Shea tree. The most common climatic factor reported to be reducing shea fruit production were strong wind(58%), too much rainfall(50%), prolonged dry spell (25%) and flooding(17%). Low fruit production was also attributed to late on- set of rains (42%) and early onset of dry season (69%).

Other negative effects of climatic factors reported were; premature fruit drop attributed to strong winds, followed by much rainfall and prolonged dry spell. Extreme climatic factors were reported to be most destructive (80%) during early flowering (11%), late flowering (6%), mid flowering (3%) and late fruiting (3%).

6.2. Threats to young plants/ saplings

6.2.1 Prolonged droughts/dry spell

With climate change, these shea districts in northern Uganda are currently experiencing prolonged droughts. This affects the survival of the young saplings /seedling because of limited water. Besides, flowering of the mature trees is interfered with changes in weather patterns. Consequently, the mature shea trees fail to produce fruits which in turn affect reproduction.

6.2.2 Rapid human population growth and overstocking of cattle

With increase in population in the area, there is need for clearing of forest land for agriculture. Since most shea trees are found in the wild, they remain to be at risk of being cut down for establishment of land for agriculture and for settlement. Large herds of cattle are likely to affect survival of the young shea tree plants. The cattle step on the young plants threatens their survival.

6.2.3 Periodic bushfires

The Shea trees especially in the Shea belt of Abim, Otuke, Agago and Kitgum Districts have been subjected to severe incessant bushfires. Fire is probably the most serious threat to conservation of Shea trees. This is frequent in the dry season. In these communities, it is culturally normal to burn the grass in the dry season and this threatens survival of Shea trees. In fact, the intensities of fires are increased when cattle is found in the area, since cattle keeper clear the old grass to kill pests such ticks that feed on the animals and encourage sprouting of new forage material.

6.2.4 Termites

Termites are wide spread in the districts and tend to attack the young shea tree saplings and seedlings. This is worse in the dry season when the trees have limited water for survival. This threatens regeneration of shea trees in the districts.

6.2.5 Unfavorable land tenure system

The current land tenure system in the 4 shea districts cannot allow shea tree plantation establishment. This is because of communally owned type of land where decisions on land are taken as a community not an individual. As a result private individual interested in planting shea trees are discouraged by this type of system to establish shea forest plantations.

6.2.6 Low level of on farm conservation of Shea tree

The major reported constraints to conservation of shea trees were land shortage and insecure tree ownership and insecurity due to internal displacement. Shortages of planting materials and inadequate advisory services on shea management were the other reported constraints to promoting conservation of shea trees in the major shea range districts in Uganda (Table 6).

Table 6: Constraints to on-farm conservation of Shea tree in the shea zones of Uganda

Constraints in the conservation of Shea tree	%
Land shortage and insecure tree tenure	95.00
High demand for shea charcoal	85.10
Frequent displacement due to insecurity	76.00
High poverty levels	66.30
Inadequate skills/advisory services for shea management	65.00
Shortage of planting materials	56.00
Long juvenile period before fruiting	46.30
Weak law enforcement in the area	40.00
Pests and disease incidences	38.80
Bush fire occurrences	37.50
Destruction by grazing animals	12.50

The over 20 years insecurity in the greater Northern Uganda has made most trees including the shea trees to be cut down leaving very few ones only. This has great implication for genetic conservation of shea trees.

Continued fragmentation of land resulting from high human population growth in the shea zones also led to a decrease in land size per household. Consequently, during cultivation of crops farmers tend to clear most of the trees. This coupled with sharing of inherited land from the parents over to the next generation(s) usually make people become reluctant to plant even the most important and highly valued trees like the shea trees. Shea trees are perceived as common property and therefore tenure rights are insecure.

6.2.7 Influence of Socio-demographic factors on conservation of Shea tree

Despite the above challenges, majority (98.75%) of the respondents are willing to conserve shea butter trees (**Table 7**). A logistic regression analysis (**Table 10**) shows that their willingness to conserve shea trees is significantly ($P \leq 0.05$) influenced by farm size, family size and sex of the household head.

Table 7: Logistic regression of socio-demographic characteristics of respondents on their willingness to conserve Shea tree

Variable	R	Odd ratio	P-Value	Significance at 5%
Sex	***4.116***	***7.814***	***0.042***	*
Age	1.248	1.504	0.264	Ns
Period of stay	1.099	1.216	0.295	Ns
Marital status	0.120	1.350	0.729	Ns
Family size	***5.082***	***0.191***	***0.024***	*
Education	0.912	1.599	0.340	Ns
Occupation	1.286	0.839	0.257	Ns
Land size	***6.124***	***3.457***	***0.013***	*

* = Significant; ns = not significant at $P \leq 0.05$

It was widely reported in the four KCL districts that decisions on whether to plant shea trees are mainly carried out by males followed by other members of the family and a few females. Just like in most African countries men are still the most influential family members in these shea districts of Uganda. They are regarded as owners of land the family occupies and in most cases have the discretion to plant or cut trees.

Since in this region, women are perceived to be usurping men's power by planting trees, it is worth noting that, while a woman makes sure she engages in a wide range of other activities to earn her own income, profits from family fields including those from shea generally go primarily to the man. This if not checked may have serious consequences on planting and protecting shea trees both on-farms and in the wild. This implies that concerted efforts are thus needed by local governments, NGOs, CBOs and cultural leaders to engender the conservation of shea trees in Uganda.

Chapter 7: Good Practices for Enhancing Conserving the Shea Trees

From reviews and interactions with communities in the 4 KCL districts, various good practices opportunities that are available and that can be used to enhance the conservation of shea trees in northern Uganda are described below.

7.1. Availability of by-laws against cutting of the Shea trees

Government has listed the Shea tree as endangered, and through local government councils, it various bye-laws banning the cutting of Shea trees for charcoal have been passed. Although the enforcement of these bye-laws is still weak, it is welcomed by some local community members who reported that it reminds them of their old traditional sacred beliefs, which prohibit cutting Shea trees. The communities believe that the Shea tree is a divine gift and anyone who cuts it would be cursed.

Accordingly, individuals and families in those places usually take initiatives to preserve Shea trees in their gardens; thereby preventing the unauthorized felling of the tree for charcoal. It is even easier for them do so where land is privately owned, than where it is owned communally (as is the case in most Shea districts).

In such instances the communities have to convince their relatives to recognize the value of preserving the Shea tree. Those who have taken the initiatives to preserve the Shea tree acknowledged that the long term benefit from preserving Shea trees is much more than the short term gain from cutting the tree for charcoal. For instance, the communities are aware of the importance of the Shea tree in attracting honey bees, which pollinate their crops and gives them honey, as well as manure for their soils.

7.2. Government directive to protect the aging shea trees

In 2006, the President of Uganda issued a directive to protect the Shea tree from overexploitation. The President also directed that a factory for Shea butter production be established in the region. In response partly to this directive, the National Environment Management Authority prepared a National Strategy on Shea tree aimed at promoting sustainable utilization of the Shea tree.

Accordingly, the Uganda Exports' Promotion Board also included Shea butter to be promoted as a bio-trade product. Uganda National Bureau of Standards, on the other hand, also, developed national standards for Shea butter and a certification scheme for small businesses, which Shea producers could benefit from.

7.3. Promotion of current on-farm conservation strategies of the shea trees

Most farmers cited several advantages of having fruiting shea trees on farm compared to in the wild. The most commonly

reported advantage was production of large nuts and prolific fruiting, protecting the trees from fires, production of sweet fruits, ease of fruit collection, production of very soft fruits, no loss of fruits to pest and wild animals, and the shea trees being able to get enough nutrients (**Table 8**). Special tending skills and conservation strategies that can be adopted for the shea tree include weeding, thinning, pruning, coppicing, pollarding, spraying against pests and diseases (**Table 9**).

Table 8: Perception on advantages of having fruiting Shea trees on farm rather than in the wild (N=200)

Advantages	% response
Large seeds/nuts	66.7
Protection of shea trees from fire	33.3
Production of very sweet fruits	19.0
Fruits are easy collect	14.3
Production of very soft fruits	09.5
Fruits are protected from pests/animals	04.8

Table 9: Major on-farm conservation strategies for Shea tree (N=200)

Parameter	%
Tending skills	
Weeding	86.30
Thinning	58.80
Pruning	56.30
Coppicing	48.80
Pollarding	16.30
Spraying	07.50
Removing the diseased	01.30
Application of manure	01.30
Location of conserved shea trees	
On-Farm	95.00
Along boundaries	81.30
On Compounds	78.80
At the hedges	66.30
Planting materials used	
Coppices	97.50
Seedlings	43.80
Cuttings	01.30
Local strategies used for conserving shea trees	
Raising them deliberately on farm	97.50
Allowing natural regeneration to grow on farms	92.50
Discouraging other people from cutting down shea tree	90.00
Ploughing & weeding around both old and young shea trees	88.75
Protecting shea trees against pests and diseases	50.00
Staking young trees from destruction by livestock	30.00
Planting shea boundaries of gardens	18.75
Use of taboos and enforcing available bye-laws	15.00
Key decision maker in shea management	
Husband	55.00
Any other family member	35.00
Wife	10.00
Willingness to conserve *V.paradoxa*	
Yes	98.75
No	01.25

While seedlings and cuttings are also used for raising shea trees to a smaller extent (**Table 9**), coppices are the main materials used for propagating shea trees (**Plate 9**).

Plate 9: Re-sprouting shea coppices from previously cut stumps in Adwari sub-county; Otuke District

In the four KCL Shea districts, shea trees are mainly found and managed on farmlands, home compounds, along boundaries and hedges). With the increased transition of land into permanent cropping systems, protection, planting and management of indigenous trees including the shea butter trees are becoming progressively more intense (**Plate 10**).

Plate 10: Shea trees conserve on various landscapes in Patongo Sub-county, Agago District.

Farmers were also aware of several opportunities that could be exploited to promote the shea industry. Such suggestions included having in place sustainable markets, strengthening existing bye-laws, better price of shea products, training farmers on silvicultural practices of shea trees, training of farmers on improved processing of shea products, protecting shea trees from fire, provision of planting materials and availability of high yielding and early maturing shea varieties (**Table 10**).

Table 10: Farmers' suggested opportunities for promoting the shea industry

Opportunities	% response
Sustainable markets for shea products	81.0
Enforcing existing bye laws	31.0
Training of farmers on shea tree silvicultural practices	29.3
Offering better prices for shea products	27.6
Improved processing of shea products	19.0
Protecting shea trees from fire	10.3
Provision of planting materials	08.6
Availability of high yielding and early maturing varieties	03.4

7.4. Good practices for improving fruit production of the shea trees

Farmers identified several interventions for improving the fruit production of *Shea tree*. These interventions included introduction of improved varieties of shea trees, provision of planting materials, enforcing existing bye-laws, practicing proper weed control, provision of pesticides for spraying and provision of better markets and control of flying squirrels respectively (**Table 11**).

Table 11: Suggested strategies for improving fruit production of Shea trees (N= 200)

Strategies	% response
Promoting growing of early maturing shea varieties	44.4
Providing planting materials	42.6
Enforcing existing bye-laws	40.7
Practicing proper weed control	03.7
Control of flying squirrels	03.7
Reduced cutting of shea trees	01.9
Having better markets for shea products	01.9
Improved processing of shea products	01.9
Providing storage facilities	01.9
Mulching the shea trees	01.9

7.5. Good practices for promoting high regeneration and fruit production of the shea tree

Majority of the respondents were of the view that shea trees in the wild usually have low fruit production, bearing small and fewer fruits. They also perceived that good tree management practices such as use of appropriate cultivation techniques could be adopted in the shea parklands of Uganda to promote domestication, marketing, increased value of the crop, on farm conservation and protection from overexploitation of the threatened shea trees.

Provision of markets, increase in the price of the nuts and other shea tree products, enforcement of the existing bye laws, farmer training, product diversification and value addition to shea tree products are some of the reported opportunities that could be exploited to improve or promote the shea industry in Uganda.

Other opportunities of high significance for policy formulation are farmer training programmes, shea processing and value addition to exploit domestic and foreign markets. Diversification of the shea tree products can be focused on its food, pharmaceuticals and cosmetics uses. Other opportunities that can promote the shea industry would include enforcement of government policies on conservation of shea trees, on setting of early bush fires and sensitization of farmers on the importance of conservation of shea trees.

Exploitation of farmers' willingness to improve production of fruits/nuts in the shea parklands of Uganda is an opportunity that should be taken on seriously by various stakeholders at both local and national levels. For example, through scientific research, farmers in Ghana can now produce early maturing shea tree that fruit in only seven years through initiating the young shea trees to sprout from the existing old stumps which are later transplanted in the field (Yidana 1994).

Training and sensitization of communities on appropriate management practices should be enforced. Such appropriate management practices are protection of shea trees from fire, weed control, soiling (addition of more soils to cover the exposed roots of the shea trees), and removal of other trees that shade the shea trees to improving aeration, light penetration and reducing above ground/ below ground competition. Controlled burning in August-September/early October and digging around the tree (spot weeding) can also be used to enhance regeneration and fruit production of shea trees.

7.6. Up scaling best practices from the Drought Resistance Resilience Project

In Karamoja sub-region, Building Drought Resilience Project has successfully addressed a breakdown of resilience of the human-ecological system through its livelihood interventions and catchment management plans. Through the project interventions, unsustainable coping strategies such as cultivation in wetlands or the cutting of the Shea tree for charcoal in the project area have been abandoned because the project was able to fill the income gaps of the people. The communities should be supported to be supported in supporting the promotion of such livelihood interventions that have sustainable coping strategies.

Chapter 8: Key Conclusions

a. Generally, shea butter tree is an important socio-economic tree species in the four districts and very many useful products such as butter oil, fruits, nuts, wood and charcoal can be obtained from it. However, increased poverty due to the effect of the war in the region has led to wanton destruction of shea butter trees as the displaced people (who were initially farmers) resorted to cutting down shea trees in great numbers to make charcoal for sale as the only way for survival.

b. Farmers preferred Shea trees with a small stature than those with a large stature as they are easier to manage and high producing. The parameters that farmers preferred from an ideal Shea tree include those shea trees with high oil, highly producing trees with large and sweet fruits and high pulp content. They have traditionally managed and conserved Shea trees through pruning branches, integrating shea trees with other annual crops, weeding around the tree, cutting dead branches to allow new ones to sprout, sparing shea trees when opening agricultural land and protecting young shea seedling against fire and browsing animals.

c. The local people have positive attitude towards planting and management of this particular tree species in the area; due to the fact that nuts/oil products from the shea butter tree command an important position in the diet of the rural community in the area.

d. Excessive cutting of shea butter trees for charcoal and firewood has led to low density distribution of shea tree compared to other indigenous tree species in the area. Although the seedlings had high density per hectare, those surviving to saplings and poles stage were very few and were not being protected against the rampant fire occurring in the area. Shea nut is facing increasing competition, particularly from imported palm oil for edible use, and from the widely advertised foreign beauty products in cosmetic use. As a result, the tree is currently not highly valued now as it was in the past. There is concern that unless more viable non-destructive uses for this tree are found, it may be locally extinct.

e. An important component for the local community is the development of organized Shea nut gatherers and training groups to supply high quality nuts. However, this aspect can only take place when markets have been identified, i.e., when there is an investor and a buyer lined up. Given that this has been established, donor assistance could be effectively used to strengthen the Shea buying networks. Northern Uganda Shea Processors Association (NUSPA) has the capacity and capability to supply large quantities of high quality, dry Shea kernels. In return for access to this valuable supply network, a primary processor could be sourced to enter into an "ethical trade" agreement with NUSPA to pay a fair price for the Shea nuts.

f. Fire was more destructive to Shea trees during early fruiting stage than during late fruiting stage, implying that early on-set of the dry season is the most critical factor influencing Shea tree fruit production. Early on-set of dry season can lead to high rate of flower loss thereby reducing fruit setting. Production and fruit retention in Shea trees were more successful on trees in the cultivated farms than those in the home compounds and in the wild.

Chapter 9: Key Recommendations

Based on the above observations and key general conclusions, the following recommendations have been made:

i. Other than cutting shea trees for charcoal which fetches little money, there is need, to diversify shea products for various markets. This would give incentive and promote shea tree conservation among the local communities who have now returned to settle back in their original homes after living in IDP camps for over 20 years.

ii. Overall government and other development partners like NGOs should come up with incentive-based approach towards planting and conservation of shea trees at household level. Rewarding households who have retained at least planted 10 mature shea trees in a year and properly managed them would motivate others to join in planting and conserving the tree species in the area. This would also enhance more equal distribution of shea trees of all size classes in the shea belt of Uganda.

iii. Since the community had been managing and conserving shea trees on their respective land before displacement, all stakeholders should come up with legal mechanisms towards promoting conservation of shea trees. All forms of institutions within the shea belt in Uganda should enforce byelaws that promote conservation of shea and other associated indigenous tree species.

iv. To ensure that cutting of shea trees for charcoal and firewood is reduced, there is need to promote awareness and sensitization programmes among the general public in the area on the socio-economic and conservation value of Shea tree. This could be done through radio talk shows, plays, public meetings and gatherings to address issues related to planting and management strategies for the shea trees. The approach would also expose the likely dangers involved in unsustainable utilization of trees in the area.

v. Although there has been interest in developing a more commercial Shea sector in Uganda since the 1940s, no rigorous in-depth studies/surveys have been done to ascertain the real levels of supply. Therefore, a useful first next step would be to conduct a comprehensive survey of Shea nut availability, domestic demand, and the importance of Shea nuts to household food security in northern Uganda and south Sudan.

vi. To improve the current processing and trade in traditional products, women's groups within the Shea belt of Uganda could be trained in the following areas: Methods of Shea storage, i.e., investigate the potential for training women's groups in storage techniques and how to manage credit in order to play a role in wholesaling the nuts; market information, i.e., train women's groups in the use of market information to evaluate the benefits of storage during the peak season; improved processing, i.e., train women's groups in improved methods for processing Shea and about the benefits of Shea in the diet.

vii. All processing ideas would need to be developed on a cost sharing basis from the outset such that the

groups would be clear that any development within the traditional sector would be through a commercial, partnership style arrangement; Oil milling, i.e., investigate the prospects of assisting the development of a medium-scale oil milling business to improve the quality and output of Shea olein production, such that the oil can compete on a better price basis with refined oils.

viii. There is urgent need for farmer training in order to change farmers' attitudes towards tree management with more input from them rather than them relying on nature. The assessment of fruit production in shea trees offers an opportunity for producing high quality shea fruits for consumption and commercialization by the shea parkland communities. This is so because improving fruit productivity and production of the shea tree can generate huge demand for improved planting materials that will scale up silvicultural practices.

ix. Conservation education and awareness creation should be promoted targeting tree management practices such as pruning, leaf removal , water catchments and conservations on farms so as to improve shea fruit productivity and reduction in the rate of cutting down of shea trees. Farmers should also be encouraged to plant other tree species for providing building poles, fire wood, charcoal and timber to avoid over dependence on Shea trees for these highly demanded products.

x. While the wild Shea tree stands should be conserved and protected as sampled trees from the wild also recorded higher fruit set (as compared to those samples from other land uses), production of commercial Shea trees in plantations (on- farm) should be emphasized. This is because Shea trees can also be cultivated like other fruit trees such as mangoes and citrus in order to enhance shea tree management and fruit productivity.

xi. Tree improvement strategies geared towards producing Shea trees with high production/prolific fruiting, high pulp content, large fruits, soft fruits and early maturity through grafting and other tree propagation techniques should be initiated and promoted among the shea parkland communities in Uganda.

xii. Instead of working to curb tree-cutting, which meets a local demand for charcoal and firewood, the local government and NGOs like Mersey Corps should consider involving people in local agroforestry projects in order to support their supplemental livelihoods. Such projects should be conducted with a special emphasis on including women, who are the primary users and gatherers of firewood, and are often risk attack to venture into the bush for firewood foraging. They are also, according to one study, less likely to perceive of problems with current tree-cutting practices. As the primary users of timber resources, sensitizations and training on trees/forestry management are likely to have greater impact when directed towards women. Gender inclusiveness, will be especially important, as there is a vital disconnect between those who ostensibly oversee natural resources (elders) and those who are using them (women).

xiii. There is a need to build on already existing programmes aimed at reducing cutting trees for charcoal. Programmes such as the World Food Programme (WFP); which is currently engaged in school tree-planting projects, improved stove-making, and the promotion of improved charcoal production techniques in Karamoja should be promoted. This programme has already identified Moringa oleifera and Pigeon pea as two species that can meet a variety of needs in the region, including firewood, nutrition, and fodder for livestock, as well as combating soil erosion.

xiv. Continued support to conservation-based Shea projects. This approach will build on the success so far achieved with regard to Shea in northern Uganda and the conservation of the Shea habitat. Whilst this approach will meet parts of the conservation strategy, it is unlikely to address the underlying economic problems that will lead to sustainable conservation, particularly in the four project districts and the northern Uganda Shea parklands in general which are particularly challenged economically. Therefore, any conservation-based approach should also consider marketing strategies and returns on investment as an integral part of any development process.

xv. There is need to increase financial support to the commercialization of Shea products. As this survey suggests, further support to the commercialization of the Ugandan Shea sector should focus on developing the food and cosmetics markets, including the national, regional, and international markets. The other opportunities of high significance for policy formulation are farmer training programmes, processing and value addition to exploit domestic and foreign markets. Diversification of the Shea tree products can be focused on its food, pharmaceuticals and cosmetics uses. Proper enforcement of government policies and regulations on conservation of Shea trees, on setting of early bush fires and sensitization of farmers on the importance of conservation of Shea trees would boost the shea industry in Uganda.

xvi. Since farmers are willing to provide plots for field study purposes, the availability of plots would also make it easy to involve the communities in on-farm improvement and production of shea fruits/nuts in the shea parklands of Uganda. However, for these to succeed, efforts are necessary from various stakeholders at local and national levels. Such efforts would involve conducting on-farm/participatory scientific research aimed at producing early maturing Shea tree that can fruit in only seven or so years through initiating the young Shea trees to sprout from the existing old stumps which are later transplanted in the field. Such participatory on-farm research has been very successful in Ghana (Yidana 1994).

xvii. Training and sensitization of communities on appropriate management practices ranging from protection of shea trees from fire, weed control, soiling (addition of more soils to cover the exposed roots of Shea trees), removal of other trees that shade the Shea trees to improve aeration, light penetration and reduced above ground and below ground competition, controlled burning in August-September and digging around the tree (spot weeding) can also be used to enhance production of shea trees.

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Appendices

Appendix I: Transect locations, GPS waypoints and distribution of shea stems per ha

District	Sub county	Transect no	Eastings	Northings	Shea juveniles/ha	Shea Poles & Saplings/ha	Mature Shea trees/ha
Otuke	Adwari	3	528023	276527	50	05	15
Otuke	Adwari	3a	529584	274630	05	05	20
Otuke	Adwari	3b	529504	282374	05	05	10
Kitgum	PalabekOgili	11a	440763	376114	10	05	10
Kitgum	Palabek Gem	11	459267	363713	30	05	40
Kitgum	Palabek Gem	12	460581	374295	30	25	25
Kitgum	PalabekKal	12a	454056	388023	10	00	20
Kitgum	Akwang	12b	472362	368171	05	05	30
Kitgum	Palabek Gem	13	467808	371609	30	0	152
Kitgum	Padipe East	14	487925	382844	10	10	10
Kitgum	Padipe East	15	492299	380438	10	15	10
Kitgum	Mucwini	16	509966	375595	10	15	00
Kitgum	Lagora	16a	514285	351908	05	10	20
Kitgum	Mucwini	17	516678	373896	15	00	35
Agago	Kotomor	18c	350233	288208	05	05	20
Agago	Kotomor	18e	530515	294443	05	05	20
Agago	Lacekocot	18	463392	327269	10	00	15
Agago	Wol	18a	522679	346304	10	05	25
Agago	Parabongo	18f	535638	328649	05	00	50
Agago	Lukole	18b	539570	319777	05	05	15
Agago	Kalongo	18d	541312	328346	05	00	50

Appendix II: Average number of shea plants per ha in different land use types from 126 plots

Land use	Juveniles/ha	Poles/ha	Mature/ha	Total shea/ha
Forest Reserve area	40	02	34	76
Long fallow	23	06	19	48
Short fallow	22	11	18	51
Grazing land	22	18	27	67
Garden /crop field	08	05	24	37
Homestead	00	00	14	14
Mean+/-Se	15+/-4.67	8+/-3.05	20.4+/-2.29	

Appendix IIIa: GPS points on transects where shea trees have been identified in Otuke District

Lot. No	District	Lat/Eastings	Long/Northings	Lot. No	District	Lat/Eastings	Long/Northings
1	Otuke	2.48887	33.26410	40	Otuke	520622	280416
2	Otuke	2.49878	33.24610	41	Otuke	520626	280426
3	Otuke	2.49917	33.25250	42	Otuke	520648	280429
4	Otuke	2.49918	33.25080	43	Otuke	520614	280439
5	Otuke	2.49942	33.25110	44	Otuke	520720	280239
6	Otuke	2.49945	33.25110	45	Otuke	520725	280244
7	Otuke	2.49969	33.24990	46	Otuke	520712	280283
8	Otuke	2.50012	33.25080	47	Otuke	520709	280292
9	Otuke	2.50019	33.25040	48	Otuke	520729	280300
10	Otuke	2.50019	33.25320	49	Otuke	520392	280473
11	Otuke	2.50022	33.25220	50	Otuke	520372	280485
12	Otuke	2.50038	33.25230	51	Otuke	520362	280479
13	Otuke	2.50052	33.24980	52	Otuke	520350	280505
14	Otuke	2.50077	33.25180	53	Otuke	520331	280504
15	Otuke	2.50077	33.25190	54	Otuke	520331	280505
16	Otuke	2.50079	33.25250	55	Otuke	520249	280673
17	Otuke	2.50098	33.25180	56	Otuke	520281	280713
18	Otuke	2.50132	33.25100	57	Otuke	520305	280675
19	Otuke	2.50141	33.25320	58	Otuke	520305	280675
20	Otuke	2.50152	33.25210	59	Otuke	528017	276550
21	Otuke	2.50184	33.25130	60	Otuke	528011	276539
22	Otuke	2.50185	33.25100	61	Otuke	528006	276512
23	Otuke	2.50220	33.25130	62	Otuke	528020	276516
24	Otuke	2.50236	33.25160	63	Otuke	528032	276517
25	Otuke	2.50325	33.25220	64	Otuke	528028	276514
26	Otuke	527957	276625	65	Otuke	528034	276509
27	Otuke	527901	276602	66	Otuke	528051	276507
28	Otuke	527877	276625	67	Otuke	528138	276554
29	Otuke	527888	276555	68	Otuke	528153	276535
30	Otuke	527997	276415	69	Otuke	528171	276526
31	Otuke	528035	276810	70	Otuke	528186	276520
32	Otuke	528012	276543	71	Otuke	528192	276523
33	Otuke	527986	276588	72	Otuke	528158	276792
34	Otuke	527936	276636	73	Otuke	528155	276778
35	Otuke	527911	276628	74	Otuke	528182	276756
36	Otuke	527981	276701	75	Otuke	528040	276955
37	Otuke	527995	276718	76	Otuke	528012	276966
38	Otuke	527968	276598	77	Otuke	528005	276979
39	Otuke	527959	276657	78	Otuke	527997	276991

Appendix IIIb: GPS points on transects where shea trees have been identified in Otuke District.

Lot. No	District	Lat/Eastings	Long/Northings	Lot. No	District	Lat/Eastings	Long/Northings
79	Otuke	527957	276625	95	Otuke	528033	276403
80	Otuke	528022	276412	86	Otuke	528131	276284
81	Otuke	528033	276403	97	Otuke	528132	276278
82	Otuke	528059	276412	98	Otuke	528142	276264
83	Otuke	528065	276414	99	Otuke	528149	276265
84	Otuke	528074	276410	100	Otuke	528124	276248
85	Otuke	528063	276382	101	Otuke	528023	276295
86	Otuke	528057	276386	102	Otuke	528014	276286
87	Otuke	528052	276377	103	Otuke	528012	276270
88	Otuke	528041	276380	104	Otuke	527998	276233
89	Otuke	528149	276355	105	Otuke	527995	276240
90	Otuke	528137	276371	106	Otuke	527981	276280
91	Otuke	528166	276383	107	Otuke	528023	276527
92	Otuke	528157	276389	108	Otuke	529584	274630
93	Otuke	528156	276390	109	Otuke	529504	282374
94	Otuke	528151	276399	110	Otuke	528131	276284

Appendix IV: GPS points on transects where shea trees have been identified in Abim District.

Lot. No	District	Lat/Eastings	Long/Northings	Lot. No	District	Lat/Eastings	Long/Northings
1	Abim	2.70947	33.64010	21	Abim	2.71187	33.63800
2	Abim	2.70973	33.64030	22	Abim	2.71192	33.63850
3	Abim	2.71008	33.63940	23	Abim	2.71208	33.63880
4	Abim	2.71015	33.63740	24	Abim	2.71263	33.63610
5	Abim	2.71042	33.63710	25	Abim	2.71285	33.63620
6	Abim	2.71055	33.63920	26	Abim	2.71315	33.63900
7	Abim	2.71080	33.64100	27	Abim	2.71332	33.63490
8	Abim	2.71105	33.63920	28	Abim	2.71363	33.63790
9	Abim	2.71112	33.64150	29	Abim	2.71383	33.63550
10	Abim	2.71118	33.64130	30	Abim	2.71392	33.63820
11	Abim	2.71332	33.63490	31	Abim	2.71218	33.63884
12	Abim	2.71115	33.63920	32	Abim	2.71214	33.63889
13	Abim	2.71119	33.64150	33	Abim	2.71010	33.63941
14	Abim	2.71114	33.63920	34	Abim	2.71159	33.63845
15	Abim	2.71121	33.64130	35	Abim	2.71190	33.63805
16	Abim	2.71392	33.63820	36	Abim	2.71194	32.63485
17	Abim	2.71060	33.63928	37	Abim	2.71319	33.63785
18	Abim	2.71363	33.63790	38	Abim	2.71213	33.63881
19	Abim	2.71196	33.63858	39	Abim	2.71321	33.63888
20	Abim	2.710612	33.63919	40	Abim	2.71291	33.63818

Appendix V: GPS points on transects where shea trees have been identified in Agago District

Lot. No	District	Lat/Eastings	Long/Northings	Lot. No	District	Lat/Eastings	Long/Northings
1	Agago	2.79832	33.31090	23	Agago	353501	401782
2	Agago	2.79844	33.31100	24	Agago	353542	401807
3	Agago	2.79847	33.31090	25	Agago	353490	401765
4	Agago	2.79860	33.31030	26	Agago	353523	401792
5	Agago	2.79898	33.31300	27	Agago	353534	401683
6	Agago	2.79955	33.31170	28	Agago	534806	309822
7	Agago	2.79988	33.31140	29	Agago	534858	309845
8	Agago	2.80096	33.31110	30	Agago	534785	309822
9	Agago	2.80197	33.31510	31	Agago	534799	309762
10	Agago	2.80235	33.31460	32	Agago	534809	309612
11	Agago	2.80354	33.31370	33	Agago	534793	309772
12	Agago	2.80389	33.31310	34	Agago	534809	309823
13	Agago	2.80401	33.31440	35	Agago	534770	309828
14	Agago	2.80439	33.31460	36	Agago	534799	309754
15	Agago	2.80500	33.31490	37	Agago	534901	309745
16	Agago	2.80579	33.31560	38	Agago	534842	309729
17	Agago	2.80885	33.31980	39	Agago	534840	309710
18	Agago	2.80941	33.31970	40	Agago	534815	309744
19	Agago	2.80968	33.31960	41	Agago	534799	309738
20	Agago	2.81265	33.31280	42	Agago	534822	309716
21	Agago	2.81289	33.31280	43	Agago	539570	319777
22	Agago	2.81327	33.31230	44	Agago	541312	328346

Appendix VI: GPS points on transects where shea trees have been identified in Kitgum District

Lot. No	District	Lat/Eastings	Long/Northings	Lot. No	District	Lat/Eastings	Long/Northings
1	Kitgum	440763	376114	12	Kitgum	454046	388033
2	Kitgum	459267	363713	13	Kitgum	487945	382840
3	Kitgum	460581	374295	14	Kitgum	509962	375590
4	Kitgum	454056	388023	15	Kitgum	459264	363716
5	Kitgum	472362	368171	16	Kitgum	514384	351948
6	Kitgum	467808	371609	17	Kitgum	472563	368270
7	Kitgum	487925	382844	18	Kitgum	036 7248	05 64308
8	Kitgum	492299	380438	19	Kitgum	036 8457	05 69427
9	Kitgum	509966	375595	20	Kitgum	036 6095	05 61196
10	Kitgum	514285	351908	21	Kitgum	040 6527	05 55085
11	Kitgum	516678	373896	22	Kitgum	040 7646	05 54454

Appendix VII: Shea distribution under different land uses from sample plots

District	Transect No.	Local Area Economic Activity	Plot no.	Plot Land use	Mature shea /plot	Sapling/ poles/plot	Seedlings/ plot
Otuke	3	Crop Cultivation	8	Shea conservation	04	00	33
			9	Shea conservation	03	00	00
			10	Short Fallow	01	00	02
			11	Short Fallow	02	02	03
Otuke	3a	Crop Cultivation	12	Long Fallow	03	00	06
			13	Garden Parkland	05	10	03
			14	Grazing	06	04	04
			15	Garden Parkland	09	05	03
Otuke	4	Crop cultivation	16	Short Fallow	07	02	11
			17	Short Fallow	07	01	02
Otuke	5	Crop cultivation	18	Garden parkland	04	00	00
			31	Long Fallow	00	34	08
Kitgum	11	crop cultivation	32	Settlement homestead	02	01	04
			33	Garden Parkland	08	10	02
			34	Long Fallow parkland	14	00	02
			35	Short Fallow	08	00	00
Kitgum	11a	Crop Cultivation	36	Short Fallow	03	00	14
			37	Short Fallow	06	00	00
			38	Grazing	07	02	10
Kitgum	12	Crop cultivation	39	Grazing	00	00	07
			40	Grazing	12	00	10
			41	Grazing	02	00	07
Kitgum	13	Crop cultivation	42	Long Fallow	00	13	11
			43	Long Fallow	03	00	04
			44	Garden parkland	07	01	02
			45	Long Fallow	00	00	06
Kitgum	13a	Crop Cultivation	46	Garden parkland	04	00	04
			47	Garden parkland	03	01	03
			48	Fallow Parkland	02	00	06
			49	Short Fallow	02	00	07
Kitgum	14	Crop cultivation	50	Garden parkland	00	00	02
			51	Long Fallow	02	01	01
			52	Long fallow	00	01	03
			53	Long Fallow	04	01	01
Kitgum	15	crop cultivation	54	Long Fallow	02	04	02
Kitgum	16	crop cultivation	55	Long Fallow	00	02	00
			56	Long Fallow	00	00	03
Kitgum	17	crop cultivation	57	Garden parkland	07	03	00
			58	Long Fallow	11	02	03
Agago	18	Crop cultivation	59	Fallow parkland	04	00	03
			60	Intact parkland	02	00	01

Appendix VIII: Questionnaire to assess roles, responsibilities and contributions of Households to management of the shea tree resources in the Kidepo Critical Landscape Districts.

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