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Cost benefit Analysis for Shea butter Use Options in the districts of Abim, Agago, Kitgum and Otuke

FINAL REPORT | MARCH 2016

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Abbreviations and Acronyms

ASP	Assistant Superintendent of Police
BTA	Benefits Transfer Approach
CBA	Cost Benefit Analysis
CBO	Community Based Organization
CIID	Criminal Investigation and Intelligence Department
CWA	Community Wildlife Areas
DAO	District Agriculture Officer
DBH	Diameter at Breast Height
DCDO	District Community Development Officer
DEO	District Environment Officer
DFO	District Forest Officer
DPC	District Police Commander
DRC	Democratic Republic of Congo
EPF	Environmental Protection Force
EPPU	Environmental Protection Police Unit
FGD	Focus Group Discussion
GEF	Global Environment Facility
Ha	Hectare
KCL	Kidepo Critical Landscape
KII	Key Informant Interview
KVNP	Kidepo Valley National Park
LC	Local Council
m	Metre
MWE	Ministry of Water and Environment
NARO	National Agricultural Research Organization
NEMA	National Environment Management Authority
NFA	National Forestry Authority
NPV	Net Present Value
OC	Officer-in-Charge
PPS	Probability Proportionate to Size
RDC	Resident District Commissioner
RPC	Regional Police Commander
UNDP	United Nations Development Programme
US$	United States Dollars
UWA	Uganda Wildlife Authority

Executive Summary

The Government of Uganda, through the United Nations Development Programme (UNDP), with financial support from the Global Environment Facility (GEF) is implementing a project, "Conservation and Sustainable Use of the Threatened Savanna Woodland in the Kidepo Critical Landscape in North Eastern Uganda". The project, implemented by the National Environment Management Authority (NEMA) in collaboration with Uganda Wildlife Authority (UWA) and relevant partners at the national and district level, aims to strengthen the management effectiveness of the Kidepo Critical Landscape (KCL) protected area systems (comprising of Kidepo Valley National Park, Community Wildlife Areas, Central and local forest reserves) and integrate protected area management in a wider landscape approach.

The project focuses on conservation of biodiversity inside and outside protected areas in the Kidepo Critical Landscape. Trees are one such element of biodiversity in the project area which is extremely important for livelihood improvement. Shea trees are faced by several threats, including charcoal burning and fuel wood collection. This study therefore conducted a cost benefit analysis of different use options for shea trees in the districts of Abim, Otuke, Agago and Kitgum in order to provide recommendations that will enhance sustainable utilization of the shea nut trees in the project area. The study assignment included conducting an assessment of the current use options of the shea trees in the districts of Abim, Otuke, Agago and Kitgum; and recommending the most suitable use option for shea tree that has least social and environmental cost but with better environmental and livelihoods benefits.

The approach taken for this study was a cost – benefit analysis (CBA) through a consultative process, using both qualitative and quantitative data gathered through a mixed-methods approach from a selected range of sources including a household questionnaire survey, focus group discussions, desk review of secondary data, market surveys and field observations. The costs and benefits were calculated for shea oil, charcoal and potentially for timber production. These are the main actual as well as potential commercial use options of the shea trees. Other uses of shea trees such as fruit pulp, firewood and cultural practices are not exclusive and were considered as secondary benefits to shea oil. Shea products from the different use options were valued using farm-gate prices and average quantities harvested per hectare. Shea fruit pulp, although widely eaten, was not included in the financial analysis because it lacks market value. However, such benefits were listed qualitatively.

Labour was accounted for in man-days. Six working hours were considered to be a man-day. Even though most farmers in the study area exclusively use family labour, man-days were valued at the cost of hiring labour for a day in the study area. The value of environmental services from shea woodlots/ forests per acre was obtained from secondary sources. Labour costs were highest in charcoal production (US$ 220 ha^{-1}), followed by oil production (US$ 132 ha^{-1}) and lowest in timber production (US$ 44 ha^{-1}). The minimum monetary value estimate of ecosystem services provided by shea woodlands was US$ 23.9 $ha^{-1}yr^{-1}$. This conservative monetary value estimate of ecosystem services was used for this study.

Financial analysis was conducted to capture returns from a private interest viewpoint. To make the alternatives comparable over time, the costs and benefits were discounted into a present value. The costs and benefits were discounted using a real discount rate and base year (2015) constant prices over a 20 year time horizon. A 20 year time horizon was chosen for comparison because shea trees in Uganda take 15-20 years to mature. This implies that if a tree is cut for charcoal, it can grow back in 20 years. Due to their extractive nature, charcoal and timber production were considered to be a one-time benefit in the planning horizon (20 years). For fruit production, shea trees were expected to continue fruiting throughout the planning horizon once the trees were mature. Subsistence firewood production was considered to be a secondary benefit of maintaining trees under the fruit production option as opposed to extractive uses. All outputs were valued at farm gate prices except firewood, which was valued at the nearby market prices. The cost calculation included the value of family labour

at the local market price. The cash flow analysis was conducted at a real discount rate (of 10%) because base year constant prices were applied. The discount interest rate in this study corresponded to the cost of capital. To evaluate profitability and return to land, the net present value (NPV) was used.

Economic analysis was also conducted to capture returns from public interest viewpoint. Shea trees provide environmental services such as carbon sequestration and soil erosion control, services that contribute to society's welfare at the local and global scale. The underlying assumption in this study was that extractive use options such as charcoal or timber harvesting will lead to loss of ecosystem services. The benefits transfer approach (BTA) was used to value ecosystem services from shea woodlands. Sensitivity analysis was performed to examine the likely influence of extraneous factors on profitability of the different options. The base-case results were subjected to sensitivity analysis, which was conducted by changing the aforementioned variables (one at a time) while keeping all other variables at their base-case values.

The study found that shea trees are distributed in the whole of the study area. The density of shea trees increases southwards towards Otuke district. Shea trees grow together with other associated species, such as Combretum and Terminalia spp. In the study area, shea trees are mainly used for the production of shea oil. Other uses of shea trees include charcoal, firewood (fuel wood), poles, furniture and cultural practices. The fruit pulp is usually eaten when ripe. Traditionally, shea trees are conserved through the use of folklore (mainly taboos), customs and rituals. Traditional management practices include on-farm retention during cultivation, weeding, bush burning, pollarding and pruning. However, shea tree traditional conservation practices are threatened by the breakdown of informal and self-imposed community restrictions. As a result, the current measures for conservation and protection of shea trees include community sensitization, community shea tree protection committees, community policing and prosecution of offenders.

The effectiveness of the different conservation measures was assessed based on the GEF Rating Scale of performance as follows:

Community sensitization (Rating = 4: marginally satisfactory).

- Community sensitisation on shea tree conservation and management (including value addition) has been promoted in the districts of Agago and Otuke in 2014.
- There has been good engagement at the local district levels by the district technical departments as well at national level by NEMA, NARO, Makerere University and local CBOs.
- However, there is lack of harmony and uniformity in approaches between the different agencies, districts and communities.
- Poor funding to the district environment sectors in particular and district local governments in general.

Community Shea Tree Protection Committees (Rating = 3: Moderately Unsatisfactory)

- The committees have are helping to enforce and strengthen the sustainable management and use of shea trees at community level.
- However, there is still rampant felling of shea trees and little or no planting.
- There is currently no provision for these committees in the district development plans and therefore no budgetary allocations.

Community Policing (Rating 4 = marginally satisfactory)

- The Environmental Protection Force (EPF) is currently complementing the efforts of government agencies, such as NEMA, NFA and district local governments in the region to monitor destruction of shea trees through sensitization.
- The Resident District commissioners (RDCs) serve as coordinators while the District Forestry Officers (DFOs) and District Environment Officers (DEOs) provide technical guidance.
- There is no documented communication strategy available at the four districts.
- The Police commands "respect" among local communities and their message is listened to, although not always adhered to.

Prosecution of offenders (Rating = 5: satisfactory)

- Several operations have been conducted between

mid-2014 to September 2015 covering all the districts in the study area.

- Several suspects were arrested and thousands of bags of charcoal were impounded.
- Hundreds of charcoal kilns were also destroyed.
- Some traders were fined according to the provisions of the National Forestry and Tree Planting Act (2003).
- Some offenders were prosecuted.
- Most people who had been prosecuted tended to avoid destruction of shea trees thereafter. Nevertheless, there are also some individuals who are habitual offenders and readily return to their habits after prosecution and punishment.
- Prosecution offers guilty individuals the opportunity to reform.

From the Cost-Benefit Analysis (CBA), the most suitable use option is shea oil. The NPV for shea oil production was US$ 8,309 ha^{-1}, which was higher than the other use options for shea trees. The NPV for charcoal production is US$ 5,766 ha^{-1} while that for timber production is US$ 4,822 ha^{-1}. Shea oil use option is by far the best compared to the other options because oil production continues throughout the lifetime of a tree once it achieves maturity. When the external costs and benefits such as climate regulation, biodiversity protection, carbon sequestration and erosion prevention are considered, the profitability of the shea oil option is even more greatly enhanced because these positive externalities continue to be gained as long as the trees exist. In contrast, charcoal and timber use options are a one-time harvest in 20 years. The economic benefits accruing from climate regulation, biodiversity protection, carbon sequestration and erosion prevention are instantly lost under the extractive use options of charcoal and timber.

In conclusion, since shea oil has been determined as the most economically viable use option for shea trees in the study area, efforts should be put in conservation of shea trees.

1. INTRODUCTION

1.1 Background to the study

Government of Uganda has, through the United Nations Development Programme (UNDP), received 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. The Project is implemented by the National Environment Management Authority (NEMA) on behalf of government, in collaboration with Uganda Wildlife Authority (UWA) and relevant partners at the national and district level.

The goal of the project is to "conserve the biodiversity and ecosystem values of the Kidepo Critical Landscape to provide sustainable benefit flows at local, national and global levels through enhanced operational capacity and functional landscape planning approaches" with the objective to "protect the biodiversity of the Kidepo Critical Landscape in north-eastern Uganda from existing and emerging threats". The project aims at strengthening management effectiveness of the Kidepo Critical Landscape (KCL) protected area systems (comprising of Kidepo Valley National Park, Community Wildlife Areas, Central and local forest reserves) and integrating protected area management in a wider landscape approach.

The project thus focuses on conservation of biodiversity inside and outside protected areas in the Kidepo Critical Landscape. By enhancing the management of biodiversity outside the protected areas, such as that of the shea butter tree, the project will improve the livelihoods of the communities within the landscape. Shea butter trees in areas within and outside the KCL are extremely important due to their ecological and economic potential for livelihood improvement. All parts of the shea butter tree can be used, including the fruits, 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.

The shea nut also provides products that benefit the global community especially in the pharmaceutical industry.

Shea butter trees are, however, faced by several threats, including charcoal burning and fuel wood collection, further underscoring the need to adopt a socio-economic landscape –wide approach to their management. This study therefore conducted a cost benefit analysis of different use options for the shea butter tree in the districts of Abim, Otuke, Agago and Kitgum and provides recommendations that will enhance sustainable utilization of the Shea nut trees in the wider landscape.

1.2 Scope of Work

The scope of the current assignment entailed conducting an assessment of the current use options of the shea butter tree in the districts of Abim, Otuke, Agago and Kitgum. The assignment involved:

1. A review of information on the ecology and distribution of shea butter trees in the districts of Abim, Otuke, Agago and Kitgum
2. An assessment of the different uses of shea tree resources and their implications on the shea tree resource;
3. An assessment of the social and economic cost of the different use options identified in 2, above;
4. Documentation of the traditional practices including role of women and men on the use and conservation of shea tree resources;
5. An assessment of the effectiveness of measures in place for the protection and sustainable use of shea butter trees at the national, district and local community level;
6. Recommendation of the most suitable use option for the shea butter tree that has least social and environmental cost but with better environmental and livelihoods benefits.

1.3 Purpose of the study

The purpose of the study was to assess the current use options of the shea butter tree and recommend those that enhance sustainable livelihood improvement and environmental quality.

1.4 Objectives of the study

1. To assess the different uses of shea tree resources and their implications on the shea tree resource;
2. To assess the social and economic cost of the different use options identified in 2, above;
3. To document the traditional practices including role of women and men on the use and conservation of the shea tree resources;
4. To assess the effectiveness of measures in place for the protection and sustainable use of shea butter trees at the national, district and local community level;
5. To propose the most suitable use option for the shea that has least social and environmental cost but with better environmental and livelihoods benefits.

2. METHODOLOGY

2.1 Study Area

The districts of Abim, Agago, Kitgum and Otuke cover a total area of 12,032 square kilometres and are located in the northern part of the country. One of the districts (Kitgum) borders with South Sudan to the north (Figure 1). The total population of the four districts is 646,154 persons, approximately 1.9% of the national population (UBOS 2014). Otuke and Agago districts are the most densely populated, with an average of 76.7 and 64.6 persons per square kilometer respectively. Kitgum and Abim districts have much lower population densities at 54.8 and 39.7 persons per square kilometer respectively.

The two largest ethnic groups in the study area are the Acholi and Lango. Other ethnic groups are the Thur and Karimojong in Abim district. The Thur form a very small ethnic group with less than 1% of the national population and are faced with extinction due to their diminishing numbers of 2,342 individuals (UBOS 2006, 2010).

In the study area, the vegetation cover can be described as Sudanian undifferentiated woodlands and Guineo-Congolean mosaics (White 1983). The dominant vegetation in the study area is composed of Combetrum/Terminalia woodland. Although most of the study area, especially Otuke and Abim districts, has experienced a large increase in human population, there are considerable areas under fallow. Fallow periods are variable and are based on human population size, with short fallows ranging between 1 and 5 years (Byakagaba et al. 2011). Long fallows may range between 5 and 10 or as long as 10–20 years (Okia et al. 2005; Byakagaba et al. 2011). Most shea trees in the study area occur on cultivated or fallow land. Most people in the area are agro-pastoralists and are heavily dependent on subsistence mixed annual cropping and livestock production for their livelihoods.

Figure 1. Map of the study area showing administrative divisions. (Inset: Map of Uganda showing location of study area (shaded area) in the country)

2.2 Study Approach

The cost – benefit analysis (CBA) was conducted through a consultative process. The CBA study used qualitative and quantitative data gathered through a mixed-methods approach from a selected range of sources including a household questionnaire survey, focus group discussions, desk review of secondary data, market surveys and field observations. This mixed-method approach enabled a comprehensive understanding of the utilization of shea butter trees, especially from the farm-household and community perspectives. The current trend in social research shows a growing tendency towards a synergy between qualitative and quantitative approaches (Harris, 2002; White, 2002). Whereas the quantitative surveys and field observations gave breadth to the study, qualitative approaches enhanced the depth required (Carvalho and White, 1997; McGee, 2000; Kanbur, 2001), for instance, in understanding issues like traditional practices, gender differentials and inherent implications of alternative shea use options. In addition, this approach provided vital leads into the inquiry as well as the opportunity for triangulating and validating the information obtained from different sources.

2.2.1 Stakeholder identification

The first stage of the CBA involved the development of a detailed work plan, identification of key stakeholders and development of data collection tools i.e. checklists and questionnaires.

2.2.2 Desk Review

A desk review was undertaken to collect and review related secondary information on the ecology and distribution of shea butter trees in the districts of Abim, Otuke, Agago and Kitgum. Review of previous reports also provided information on the different uses of shea tree resources, their contribution to the livelihoods of communities as well as implications on shea tree abundance. A review of the current literature provided background information about the issues being investigated such as environmental services from shea trees and also facilitated detailed characterization of shea butter trees.

2.2.3 Reconnaissance surveys and recruitment of field assistants

A reconnaissance survey was conducted in the four districts. The reconnaissance survey provided critical information for refining the methodology and the data collection tools. The reconnaissance survey was used to test the data collection tools, identify likely key informants and groups and select villages and households for the follow-up survey. The reconnaissance survey was also used to select and train field assistants and enumerators. The enumerators and field assistants were selected based on their knowledge of the study area and selected communities, ability to speak the local language and their level of education. In addition, this stage was used to introduce the research team to the relevant local leaders and the district forestry offices.

2.2.4 Focus group discussions (FGD) and key informant interviews (KII)

The CBA utilized key informant interviews; semi structured household interviews and focus group discussions with the stakeholders – Individual household members, Local community members, Village opinion leaders and central government representatives (Local Councils or LCs), District officials such as District Forest Officer (DFO), District Agriculture Officer (DAO), District Community Development Officer (DCDO), etc., Private Sector and Community Based Organizations (CBOs). Focus group discussions with community level stakeholders communities mainly employed the use of check lists while individual household information was solicited through semi-structured interviews. The questions were derived from the entire scope of the assignment, as outlined in section 1.3 above.

In order to discuss alternative view points and generate consensus on various issues, nine focus group discussions (FGDs) were conducted in the shea tree growing communities in the study districts (Annex II). Drawing from the preceding desk review and reconnaissance survey, the FGDs generated information about the different shea tree use options and teased out their social and economic implications. These discussions enabled a detailed understanding of the typical management regimes and perceptions of shea butter trees, as well as the institutional contexts in which shea tree utilization and conservation processes are embedded.

Nine key informants who included experienced practitioners in various shea tree use options and district technical staff, were interviewed to obtain specialist information in substantial depth. These interviews offered the opportunity to obtain further information and to verify information given by other respondents. The experienced practitioners provided expert opinion on traditional practices, dynamics of different shea use options and their implications on shea resources. District technical staff provided information about the laws and regulations for use of the shea tree and the environmental implications of the different use options. Local leadership and CBOs provided an objective analysis of the entire shea system, with particular attention being paid to measures in place for protection and sustainable use of shea tree resources.

2.2.5 Household Survey

Multi-stage stratified cluster random sampling was used to select farm households with shea butter trees. This sampling method was found to be appropriate because it reduces costs per sample point. This has been found to be a useful attribute to this method and does not necessarily compromise precision (Edriss, 2013; de Vaus, 1996; Neuman, 2000). The strata were based on sub-county, village and household. In the first stage, farm households were stratified by the four districts. In the second stage, one sub-county was purposively selected from each district on the basis of shea tree density. Four villages were then randomly selected from a list of villages in each sub-county. The sampling frame for the households with shea butter trees on-farm was provided by officials of village local governments (councils). The households were then sampled according to their population proportions by sub-county. Sampling was based on probability proportionate to size (PPS) in order to ensure that each stratum was proportionate to the population size of the stratum. This meant that each stratum had the same sampling fraction. A full schematic representation of the study process is shown in Figure 2.

The sample size for household questionnaire survey was determined to be 124 using the following formula (Edriss, 2013):

$$n = \frac{Z^2(1-P)P}{e^2}$$

Where: n= number of households, Z = 1.96 (2 tailed test), e = 0.05 (margin of error) and p = estimated proportion of farmers with shea butter trees on farm (0.1). After adding 4% for non-respondents and 2% for design effects[1], 124 household were sampled.

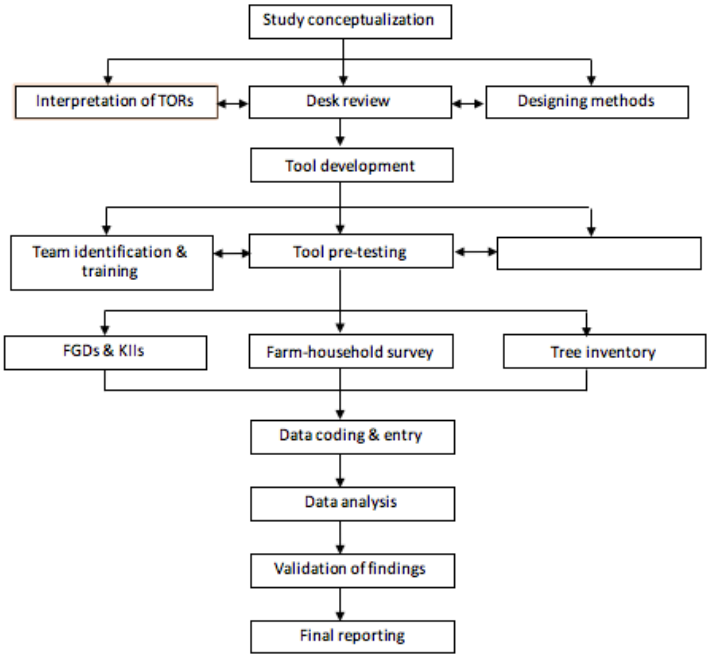

Figure 2. Schematic representation of cost-benefit analysis

[1] A default value of 1.5 to 2.0 for design effect is typically used.

A household questionnaire survey was used to obtain quantitative data on costs and benefits of different shea use options from 124 households in the shea trees. Data on the social, financial and environmental costs (per hectare) associated with each shea butter tree use option were compiled for utilization in the CBA. This included costs such as farm inputs, labour requirements, management regimes and loss of tree cover. Similarly, data on the social, financial and environmental benefits (per hectare) associated with each option were collected. The data included the quantity of yields harvested per season per hectare and farm-gate prices from the alternative shea butter use options. The questionnaire also solicited information about the social-demographic characteristics (i.e. details of the age, education, household size, wealth status, sources of income, etc.) and household's livelihood activities.

2.2.6 Field Observations

Field observations were performed in a selected number of farms in the study area to ascertain the density of shea butter trees per hectare. The importance of these field observations was to collect data that were useful in determining approximate yield characteristics of shea butter trees. This information was useful in estimating the costs and benefits accruing to the range of use options available for farmers. In addition to stocking density (stems/ha), diameter at breast height (DBH at 1.3 m) and tree height (m) were also sampled.

2.3 Estimation of Costs and Benefits

Cost-benefit analysis evaluated three main commercial shea tree use options (i.e. for oil, charcoal and potentially for timber). Other uses of shea trees such as eating of fruit pulp, firewood and cultural practices are not exclusive (depend on availability of the three main options) and were considered secondary benefits to the shea oil production option in this analysis. Shea products from the different use options were valued using farm-gate prices and average quantities harvested per hectare.

The average shea fruit pulp, kernel and oil production per tree over the harvesting season were extrapolated to a hectare on the basis of average tree densities in the study area. Shea trees have one fruiting season per year. Shea fruit pulp although widely eaten was not included in the financial analysis because it lacks market value. However, such benefits were listed qualitatively.

Figure 3. Earth-mound method of charcoal production

A sample of mature shea butter trees in the study area indicated height ranging between 12-19 metres and diameter at breast height ranging between 11-42 centimeters. The group discussions with the commercial charcoal producers also established that one mature shea butter tree could produce about five bags of charcoal (Table 1) using the traditional/ earth mound method of charcoal production (Figure 3). Similarly, FGDs revealed that the average mature shea tree could produce 5 pieces of timber of (9 x 1) inch dimensions. This is because most shea trees were crooked and heavily branched (Figure 4). Questionnaire interviews revealed that on average households collected 2 headloads of firewood from shea trees per month and 10 litres of shea oil per tree per season (Table 1). Although, firewood is generally used for domestic consumption, it was included in the cash flow analysis because it has market value in the urban centres.

Labour was accounted for in man-days. Six working hours were considered to be a man-day. Even though most farmers in the study area exclusively use family labour, man-days were valued at the cost of hiring labour for a day in the study area. The value of environmental services from shea trees per acre was obtained from secondary sources using the benefit transfer method.

Figure 4. Mature shea tree

Table 1 indicates that the labour costs were highest in charcoal production (US$ 220 ha^{-1}), followed by oil production (US$ 132 ha^{-1}) and lowest in timber production (US$ 44 ha^{-1}). The minimum monetary value estimate of ecosystem services provided by shea woodlands was US$ 23.9 $ha^{-1}yr^{-1}$. This conservative monetary value estimate (Table 1) of ecosystem services was used for this study.

Table 1: Inputs and outputs of shea use options

Inputs/outputs	Physical quantities			Price (US$)	Value (US$)	Source
	Units	Range	Mean			
Mature shea tree density	Trees/ha	30-75	38[2]	-	-	a
Shea fruits	Basins/tree	2-12	5	-	-	a
Shea kernel	Cups/tree	60	60	-	-	a
Shea oil	Litres/tree	10	10	2.61/litre	991.8/ha/yr	a
Charcoal	Bags/tree	5	5	4.35/bag	826.5/ha	a
Firewood	Head loads/ha/yr	24	24	0.58/head load	13.92/ha/yr	a
Timber	Pieces/tree	5	5	2.9/piece	551/ha	a
Labour charcoal	Man-days/tree	5	5	1.16/man-day	220.4/ha	a
Labour oil	Man-days/tree	3	3	1.16/man-day	132.24/ha/yr	a
Labour timber	Man-days/tree	1	1	1.16/man-day	44.08/ha	a
Ecosystem services						
Raw material	US$/ha/yr	7- 659	-	-	7/ha/yr	b
Climate regulation	US$/ha/yr	9- 387	-	-	9/ha/yr	c
Biodiversity protection	US$/$ha^{-1}$/$yr^{-1}$	0.46	-	-	0.46/ha/yr	c
C sequestration	US$/ha/yr	2.65	-	-	2.65/ha/yr	b
Erosion prevention	US$/ha/yr	4.8			4.8/ha/yr	d

Sources: a: field data collection, b: Emerton (1998), c: de Groot et al. (2010), d: Rodriguez et al., (2006)

Cost-Benefit Analysis (CBA) is a widely used project assessment method that is used for the economic evaluation of competing land uses (Boardman et al. 2001). In this study, the financial and economic viability of the shea use options were assessed. To achieve this, the average annual costs and benefits per acre or hectare were computed for each shea butter use option.

2.3.1 Financial Analysis

Financial analysis was conducted to capture returns from a private interest viewpoint. To make the alternatives comparable over time, the costs and benefits were discounted into a present value (Gittinger 1982, Graves 2007). The costs and benefits were discounted using a real discount rate and base year (2015) constant prices over a 20 year time horizon. A 20 year time horizon was chosen for comparison because shea trees in Uganda take 15-20 years to mature. This implies that if a tree is cut for charcoal, it can grow back to full production in 20 years. Due to their extractive nature, charcoal and timber production were considered to be a one-time benefit in the planning horizon (20 years). For fruit production, shea trees were expected to continue fruiting throughout the planning horizon once the trees were mature. Subsistence firewood production was considered to be a secondary benefit of maintaining trees under the fruit production option as opposed to extractive uses. All outputs were valued at farm gate prices except firewood, which was valued at the nearby market prices. The cost calculation included the value of family labour at the local market price.

The cash flow analysis was conducted at a real discount rate of 10%. The discount interest rate is the desired minimum interest rate. In this study it corresponds to the cost of capital. It means that if the calculated rate of returns is greater than the interest rate charged by the bank, then the investment is financially viable. The study used the real discount rate because base year constant prices were applied. The real discount rate is represented as: Real discount rate = nominal discount rate – inflation. Various investment criteria exist to compare the profitability of alternative projects. In this analysis, the net present value (NPV) was used to evaluate profitability.

(i) Net Present value

Given the scarcity of land, the objective was to maximize returns per unit of land. Return to land was expressed by net present value (NPV). NPV determines the present value of net benefits by discounting the streams of benefits and costs to the base year. The NPV of each shea use option was calculated using the following formula:

The profitability indicator was the net present value (NPV) and was computed as shown in the table below:

Profitability indicator	Formula	Decision criteria
NPV	$\sum_{t=0}^{t=n} \frac{B_t - C_t}{(1+p)^t}$	NPV1 ≥ NPV2

B = Benefit; C = Cost; t = Production Period or time in years; p = Discount Rate; n = Rotation length in years.

The NPV is regarded to be a superior measure of profitability compared to other discounted cash flow techniques such as the IRR (Internal Rate of Return) when choosing among mutually exclusive alternatives.

2.3.2 Economic analysis

Economic analysis was also conducted to capture returns from public interest viewpoint. Whereas, financial analysis evaluates private profitability, economic analysis evaluates public profitability. Financial analysis estimates the benefits and costs for each shea use option based on market prices. It does not include non-market costs and benefits such as environmental services. However, shea woodlots provide environmental services such as carbon sequestration and soil erosion control. These services contribute to society's welfare at the local and global scale. Therefore, economic analysis valued and internalized the ecosystem services. The foregoing assumption in this study was that extractive use options such as charcoal or timber harvesting will lead to loss of ecosystem services.

[2] We used a mean value of 38 trees per hectare (as given from the focus group discussions) to compute the costs and benefits accruing from shea tree use. This compares well with other empirical studies on shea tree densities in Uganda. Byakagaba et al. (2011) enumerated shea tree densities in northern Uganda and obtained between 6 and 55 mature shea trees per hectare. Okullo (2004) counted 34 individuals per hectare in the Lango farming system.

2.3.3 Valuation of ecosystem services

Due to limited time and resources, the benefits transfer approach (de Groot et al., 2010) was used to value ecosystem services from shea woodlands. The benefit transfer approach provides unit estimates of the value of particular ecosystem services based on estimates calculated in more detailed studies of similar sites. In this study, the unit value of ecosystem services was derived from previous studies by Emerton (1998), Turpie (2003) and de Groot et al. (2010). The unit values for ecosystem services from woodlands in countries with similar environmental, climate and economic status were used in this study.

Some analysts have argued that economic values of ecosystem services estimated by the benefit transfer approach have many shortcomings and limitations. They contend that the values are, by definition, context dependent, marginal and state dependent (Goulder and Kennedy, 1997; Baumgartner et al., 2006, Barbier et al., 2009). However, despite these fundamental issues in economic theory and practice, information about the monetary importance of ecosystem services is a powerful and essential tool to make better, more balanced decisions regarding trade-offs involved in land use options and resource use. The estimates are intended to provide an indicative value rather than a precise value. Even a primary valuation study may not offer a precise value for a non-traded ecosystem services.

2.3.4 Sensitivity analysis

Sensitivity analysis was performed to examine the likely influence of extraneous factors on profitability of the different options. The base-case results would be expected to be affected by shea tree density, yield (shea fruit productivity) and discount rate. Therefore, these variables were subjected to sensitivity analysis. Sensitivity analysis was conducted by changing the aforementioned variables (one at a time) while keeping all other variables at their base-case values. Therefore, the mature shea tree density range (30 – 75 tree ha^{-1}), discount rate (5 – 15%) and fruit productivity of (2 – 12 basins tree-1) were tested in the sensitivity analysis.

2.4 Limitations

This study relied on information generated through primary data gathering and secondary sources. Although all opportunities for triangulation were sought, the reliability of the information depended on full access to the required sources of such information. In addition, since the project area is a vast region with poor road network, especially during the rainy season, access to field sites depended so much on the weather prevailing at the time of this field work. Finally, progress of the study depended on timely release of funds and any other necessary assistance from the National Project Office/NEMA.

3. ECOLOGY AND DISTRIBUTION OF SHEA BUTTER TREES

3.1 Shea butter tree ecology

Shea trees are small to medium-sized deciduous trees that grow up to 20 – 30 m in height. They have been noted to take on different tree forms (Boffa, 1995; Hall, et al. 1996). There is wide variability in tree form, ranging from short twisted, multiple stems to tall, straight, un-branched boles. Shea trees have, therefore, been described variously as a small to medium sized deciduous trees, 10 – 15 m high; as 3 m shrub – like trees; as high canopy trees of 30 m. The diameter of mature tree crown has been recorded to range between 30 – 60 cm, with figures as low as 7 cm and as high as 200 cm (Boffa et al. 1996; Fontaine et al. 2004). The leaves are stipulate and are usually in terminal rosettes. The flowers are axillary, fragrant and usually clustered at the end of the short shoots. The fruits contain a large solitary seed (sometimes the seeds can be 2 or 3) and the cotyledons contain abundant fat and oil.

Shea tree reproduction is marked by seasonality in flowering and fruiting. Bud production in Uganda occurs in December to January while flower production occurs from January to February (Okullo, 2004). Initial fruit production occurs at 15 – 20 years (Okullo, 2004; Okullo et al. 2004) while full production is reached at 40 – 50 years (Okullo, et al., 2004). Fruit yield varies from one year to another and is cyclic in nature, being influenced by climatic, anthropogenic and genetic variability (Kelly et al. 2007; Maranz & Wiesman, 2003). Shea trees grow in open parkland savanna sites on different soil types, excluding alluvial and flood plains. They are tolerant to fires, their thick bark acting to protect the delicate inner tissues from fire damage.

3.2 Shea butter tree distribution in Abim, Agago, Kitgum and Otuke

Within Uganda, shea trees are distributed in the whole range of the savanna dry lands above 1° of latitude. The southern-most distribution is in Pallisa district in eastern Uganda while to the west, it occurs in Nakasongola Masindi Nebbi and Arua districts across into the Democratic Republic of Congo (DRC). To the north, its occurrence is contiguous with its southern Sudan distribution. The species therefore occurs in eastern, mid-western and northern Uganda.

Within the districts of Abim, Agago, Kitgum and Otuke, shea trees are distributed all over (Figure 5). Although 20 years ago, there was documented evidence that there was much higher density in Otuke compared to any other part of the country (Masters and Puga, 1994), so much cutting of shea trees has taken place especially during the period of the civil war (1986 – 2004) that this may not be true anymore. In Abim, there are scanty populations of shea trees towards the eastern part of the district in the sub-county of Alerek (Figure 5).

The extent of distribution of the shea trees in the study area is shown Figure 5. The red dots indicate actual trees that were geo-referenced as part of this study. However, absence of a red dot does not, therefore, necessarily indicate absence of shea trees. Geo-referenced data collected indicates that the highest concentration of the trees was in Otuke and Agago districts. On the other hand, the shea trees were sparsely distributed in Kitgum and Abim districts.

Figure 5. Shea tree distribution in the study area.

4. UTILISATION OF SHEA TREE RESOURCES

4.1 Diversity of uses of shea tree resources

There are several uses of the shea tree in the four districts under study as shown in Figure 6.
Shea trees are very central to the livelihoods of households and communities in the region, given their multiple uses. Although nearly all parts of the tree are useful, most people regard oil from the tree as the most important resource there from (Figure 6). At household level, shea oil is a major part of local diet. The pulp from the fruits is also eaten. In addition, the bark of shea trees is medicinal and is commonly used to treat wounds, diarrhea and preservation of dead bodies. Other uses of the tree within households include enhancing honey quality, serving as a mosquito repellant, curing scabies and a source of cash income. Culturally, the shea tree is a respected traditional tree, and is seen as a symbol of common identity in society.

Almost all the shea tree plant parts are used for various purposes, ranging from food, social to spiritual purposes (Table 2). However, the tree is most prominently valued for its oil. Over 77% of responses from the field study (Table 2) pointed at shea nuts, which are used in the production of oil as the most diversely used shea tree product. The diversity of uses associated with shea oil reveals the importance which is attached to this shea tree product. The second most frequently mentioned product (12% of responses) was the fruit pulp. The uses of shea trees for firewood, charcoal, domestic tools and poles were less frequently mentioned (at less than 2% of the responses referred to the use of shea trees for charcoal or firewood). However, field observations showed numerous stumps and recently felled shea trees for charcoal burning. It is understandable that there were few responses regarding the use of shea trees for charcoal and firewood. The district officials and the national environmental police have increased efforts at curbing the burning of shea trees for charcoal.

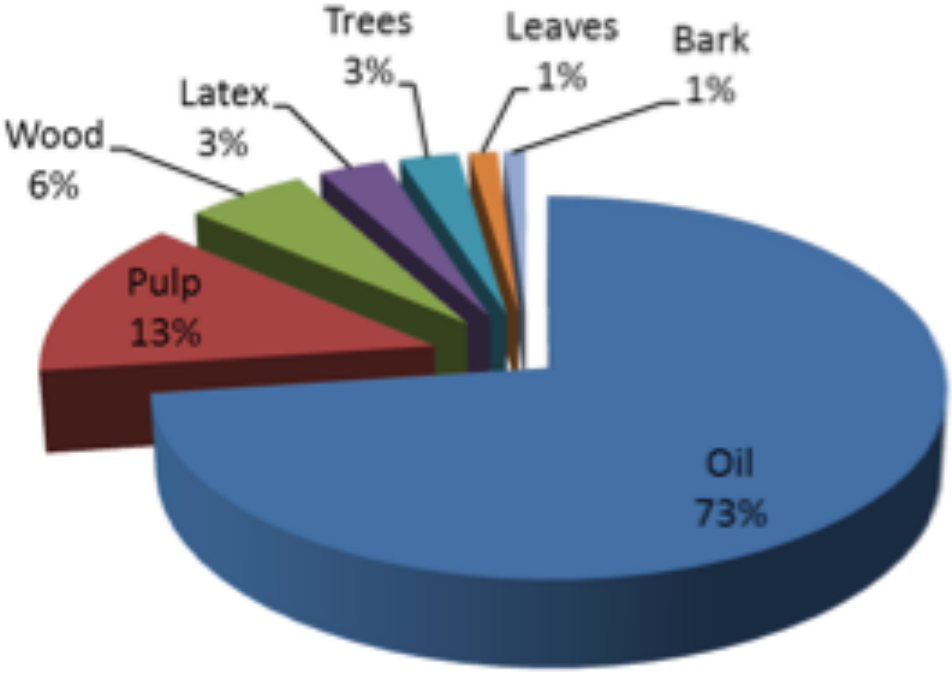

Figure 6. Different uses of shea trees in the districts of Abim, Agago, Otuke and Kitgum.

Table 2. Current uses of shea trees and their products

Plant Part	Use	N	% of Responses	Plant Part	Use	N	% of Responses
Nut/ Oil	Cooking	25	20.2	Nut/Oil	Spiritual appeasement	1	0.8
	Body/hair lotion	23	18.5		War potions	1	0.8
	Sale	17	13.7		Chase demons	1	0.8
	Treating wounds	4	3.2		Food preservation	1	0.8
	Child birth	3	2.4		Twin birth ceremonies	1	0.8
	Bride price	2	1.6		Funeral rites	1	0.8
	Lubrication	2	1.6		Funeral rites	1	0.8
	Soda ash	2	1.6	Pulp	Eaten when ripe	15	12.1
	Insect repellent	1	0.8	Wood	Firewood	2	1.6
	Traditional costumes	1	0.8		Charcoal	1	0.8
	Soap making	1	0.8		Domestic utensils	1	0.8

Environmentally, shea trees provides a multiplicity of ecosystem services, which include rainfall modification, increasing soil nutrients, soil and water conservation and increasing soil micro-organisms, bee foliage as well as serving as wind breaks. The impact of tree cutting used not to be a major factor in the depletion of the shea butter tree. However, with the current switching to alternative sources of oil and fat and local disappearance of fuel wood species, there is bound to be a significant increase in the exploitation of the shea butter trees to meet fuel wood (charcoal) requirements (pers. obs.).

4.2 Utilization of shea tree products

4.2.1 Shea oil

The shea nut is highly valued for its oil rich kernels which produce oil that is used by local communities for cooking, cosmetics and medicine (Figure 7). Shea oil is also used as an illuminant, in soap making, and as a hair and skin lotion. The most popular uses of shea oil are for cooking (28%, n=124) and as a skin/hair cream (27%, n=124). It is also worthwhile to note that a significant proportion of households (19%) use shea oil as their source of income.

4.2.2 Fruit Pulp

The shea tree also produces a fruit whose pulp is sweet and edible when ripe and is critical in terms of food security among the communities in the study areas. The fruit pulp is widely consumed and the fruit usually ripens at a very critical time of the year – the early part of the rainy season – when labour – intensive farming operations need to be carried out, and yet there is prevailing hunger due to depletion of stored food reserves. The importance of the fruit pulp among both children and adults at this critical period is therefore considerable. However, the widely recognised dietary and socio-economic value of the shea nut and its oil extract seem to have diminished the usefulness attached to the shea fruit pulp, which is also very important. In some African countries such as Burkina Faso, communities are involved in value addition initiatives in which there is local processing of shea fruit pulp to produce fruit jam (Sanou & Lamien, 2011).

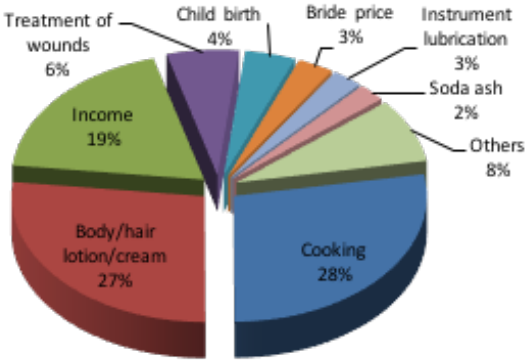

Figure 7. Different uses of shea oil in the districts of Abim, Agago, Otuke and Kitgum

4.2.3 Wood

Wood from shea trees has multiple uses. It can be used for firewood, charcoal and construction for furniture as well as pounding mortars (Figure 8). In the districts of Abim, Agago, Otuke and Kitgum, large mature Vitellaria trees are preferred for making mortars, charcoal burning and poles for building houses (21% of responses). In spite of its economic importance as a source of cooking oil, the shea trees in the study area are under heavy pressure from communities who are exploiting it for fuel wood (45%) and charcoal making (21%). The period of civil war in the shea belt (1986 – 2004) destroyed all the traditional economic infrastructure that communities used to rely on. This has therefore exacerbated the problem of cutting of shea trees for fuel wood and charcoal as a means of financial survival.

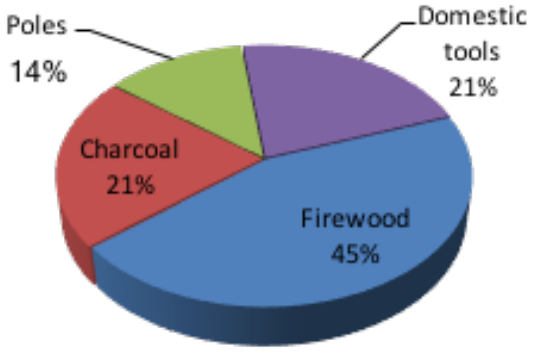

Figure 8. Different uses of shea tree wood in the districts of Abim, Agago, Otuke and Kitgum

4.2.4 Other tree products

Besides the products highlighted above, shea tree also produces other products such as: latex, and tree leaves. According to the findings of the household survey interviews; 3% of the households reported using latex, while a very small proportion (1%) reported using shea trees for shade, wind breaks and soil and water conservation purposes. Households also reported use of shea tree bark mainly for purposes of decorating pottery. Other than these, the shea also is used for cultural (twin birth ceremonies, funeral rites, household decorations) as well as spiritual (appeasing/chasing demons away) purposes.

4.3 Utilization of shea tree resources: Implications and the role of men and women

Analysis of the different uses of the shea tree reveals a wide range of implications on the shea tree resource. Among all the major uses of the shea tree resource, charcoal burning and fuel wood are the most detrimental since these are un sustainable. Continued exploitation of shea trees for charcoal making and fuel wood are likely to lead to extinction of the shea nut butter tree in the area.

Within the context of the study area, gender roles strongly define how men and women relate especially in terms of the different uses of shea. Traditionally, men have been involved in harvesting of the shea tree resource for fuel wood and charcoal burning; while women are predominantly involved in the collection and processing of non-wood products. Traditionally, processing of butter is carried out by individual women or informal women groups who pool their resources together. Similarly, the shea nut oil is predominantly used by women as body or hair lotions/creams. Women rely on the income generated from selling butter extracted from the shea nuts. They also use this butter for preparing culturally appropriate foods for their households.

Men are more likely to use shea tree resources to produce charcoal which has a superior quality compared to charcoal from other tree species. They also use shea for building poles, medicine and shade. Shea local remedies can be used to increase milk production in lactating mothers. To ensure sustainable management and conservation of the species, the economic returns from the local processing and marketing must be sufficient to satisfy the needs of both men and women.

5. SOCIAL AND ECONOMIC COSTS OF DIFFERENT SHEA TREE USE OPTIONS

In the analysis of social and economic costs of different shea use options, this study categorized these into a dichotomy of "destructive" and non-destructive" uses. By destructive uses are those uses that are done as a one-time undertaking and inevitably result in the destruction/death of the shea tree. These include use of the tree for charcoal, firewood and timber production. Non-destructive use options on the other hand, are those that happen in a recurrent manner and can be realized over an extended period during the life span of the tree. Among these are use of the tree for oil, pulp and medicines. To a large extent, the social and economic costs of a shea use option depend on which of the above two categories it falls.

5.1 Costs of using shea trees for wood

Charcoal burning, firewood cutting and timber sawing are the main forms in which shea trees are used for wood. From the above categorization, these uses are among those defined as destructive. The social costs associated with these uses are higher considering that these options sever/compromise the supply of benefits from the non-destructive uses.

Brick burning results in reduction in shea tree stands leading to reduced production of shea fruits and their products. While felling of shea trees may provide short term benefits to the individual or household involved, in the long run, it tends to increase poverty levels by eliminating an important source of income. Given the subsistence nature of livelihood strategies in the region, prospects of returns from brick burning being invested to expand the household income base are often slim.

The danger facing the tree threatens to not only eliminate it from the landscapes but also erode the rich culture and traditional knowledge within societies about its usage and management. For long, shea trees and their products have formed an integral part of social norms and traditions. Shea oil is especially important in antenatal treatment for pregnant women, but is also used in child rearing, marriage ceremonies as well as burial procedures. The use of shea trees for charcoal threatens the sustenance of these and other aspects of local culture.

Shea oil is also a major part of local diet and its unavailability as a result of tree cutting definitely affects household nutrition status. The oil has nutritive attributes that are beneficial to human physiological wellbeing. Its use in spicing up other foods enhances their palatability, making the search for food less strenuous, especially for women and girl children in whose domain household culinary responsibilities fall. The use of shea trees for brick making and charcoal therefore, renders the opposite true.

Using shea trees for wood also compromises a primary source of shade both in homesteads and on crop gardens. During dry seasons shea trees around the homestead provide an important refuge for humans and livestock from the scotching sunshine. Such trees are not only where households share the lunch meal, but also where casual visitors are entertained. Shea trees retained on croplands serve as resting places for cultivators. Many local artisans e.g. bicycle mechanics, cobblers and black smiths also commonly operate under shea trees. Although destructive use of these trees may not eliminate such activities per se, it is likely to render them unnecessarily cumbersome in some contexts.

In addition, the destructive use of shea trees has environmental outcomes that affect communities in different ways, with a wide range of social implications. Distortion of rainfall patterns for instance, as a result of tree cover loss exposes farmers to higher risks of crop loss, which may translate into famine and increased poverty. By eliminating the environmental benefits that trees and forests provide, households and communities are rendered less resilient to the adverse effects of climate change like drought, strong winds and extreme temperatures.

5.2 Costs of using shea trees for shea oil

The use of shea trees for oil is a typical form of non-destructive use of the tree. Given that this use option is continuous, it comes along with an entire range of benefits from shea trees. The social and economic cost involved are in relation to the fact that using shea trees for shea oil requires trading off destructive uses which potentially offer quick returns in the short term.

Shea trees are regarded as communal resources and collection of shea fruits from trees is done with minimal restrictions. This state of affairs presents challenges, however, with shea trees located on croplands as fruit collection often increases instances of crop being trampled upon. Imposing strict restrictions to trees on one's crop gardens could be a source of social tensions and conflicts. Nonetheless, open access to these trees may be equally destabilizing of social relations between cultivators and shea fruit collectors.

Shea oil processing and trade is dominated by women and where no alternative income sources for men exist, this may invert the gender prism by putting resources in the hands of the women. In some instances this has led to men developing a sense of insecurity as their headship of households is put to question. In some households, men take over the marketing roles after the women have done the processing. This in itself is a potential source of intra-household conflict as the distribution of benefits from the entire process is often not in proportion to efforts invested therein.

6. TRADITIONAL PRACTICES IN USE AND CONSERVATION OF SHEA TREE RESOURCES

Traditional practices are universally recognized as a basis for conservation of biodiversity. However, such practices are often not included in natural resource conservation policies. This is partly due to the narrow definitions of conservation and failure to appreciate the 'immense conservation capital' in traditional systems. In most cases, traditional conservation consists of informal measures that are largely 'invisible' in conventional analyses. An inherent feature of traditional conservation is the central role of cultural and traditional practices.

Traditional conservation practices include on-farm retention during cultivation and the use of folklore (mainly taboos), customs and rituals. Traditional management practices include weeding, bush burning, pollarding and pruning. Contemporary farmers spare particular trees with desirable characteristics including those used in traditional rituals and only cut those that are of undesirable form, usually the smallest in size or those that are unproductive. Apart from cutting, undesirable trees are sometimes ring barked to kill them. Further, shea tree traditional conservation practices are threatened by the breakdown of informal and self-imposed community restrictions.

There are several practices that are utilized by local communities in the management and agronomy of shea trees in the four districts under study (Table 3). The current practices in the utilization of shea trees are very much driven by sociocultural as well as economic realities. There seems to be a lot of traditional knowledge available in the communities regarding the utilization of shea trees. This knowledge is reflected in the practices, which are diverse and range from germination of shea trees in the fields to post-harvest handling and sale of shea products such as shea oil.

A number of respondents intimated that utilisation of shea trees is driven by taboos and cultural practices. For example, fruits are only picked from the ground after falling from the tree when ripe. A lot of cultural beliefs are associated with this practice, which in itself is immensely useful for the conservation as well as ensuring that only ripe almonds are picked from the tree.

Table 3. Different management practices of shea tree agronomy in the districts of Abim, Agago, Otuke and Kitgum

Practice	N	% Responses
Weeding	67	54.0
Pruning	25	20.2
No cutting	11	8.9
Burning/fire protection	8	6.5
Pollarding	5	4.0
Spraying	2	1.6
Coppicing	2	1.6
Mulching	2	1.6
Manuring	1	0.8
Staking	1	0.8
	124	100.0

7. CURRENT MEASURES FOR CONSERVATION AND PROTECTION OF SHEA TREES

A number of measures have been put in place for the protection and sustainable use of shea trees both at national, district and community levels. Some of these measures include: community sensitization; shea tree protection committees, community policing and prosecution of offenders besides others. In this section, the effectiveness i.e. the extent to which the current conservation measures contribute to achieve the intended outcomes are discussed. Assessment was based on a 6 point GEF rating scale as show in table 4 below:

Table 4. Six point GEF rating scale for assessment of effectiveness

Scale	Achievement	Description
1	Highly Unsatisfactory	The intervention has severe shortcomings in the achievement of its objectives
2	Unsatisfactory	The intervention has major shortcomings in the achievement of its objectives
3	Moderately Unsatisfactory	The intervention has significant shortcomings in the achievement of its objectives
4	Marginally Satisfactory	The intervention has moderate shortcomings in the achievement of its objectives
5	Satisfactory	The intervention has minor shortcomings in the achievement of its objectives
6	Highly Satisfactory	The intervention has no shortcomings in the achievement of its objectives

While there have been positive strides in terms of effectiveness, there are some mitigating factors that have impeded all-out achievement of shea tree conservation.

Community sensitization: According to the Water and Environment Sector performance report of 2014 (GoU, 2014), shea tree conservation and management has been promoted through community sensitization. During the year 2014, the districts of Lira, Agago and Otuke were sensitized on sustainable management and use of the shea trees, with focus on conservation and value addition. The extent to which progress towards complete community awareness of shea tree conservation and value addition can be rated as good. Given the testimony from community members and district officials, and on-going discussions at the national level (especially through NEMA), it is clear there is some movement towards effectiveness of community sensitization. There has been good engagement at the local district levels by the district technical departments as well at national level by NEMA, the National Agriculture Research Organization (NARO), Makerere University and local CBOs. Information from focus group discussions in Kitgum indicated that Kitgum Women Beekeepers' Association (KITWOBEE), a local women's group is actively promoting the use of shea trees for bee keeping. However, the effectiveness of community sensitization has been compounded by the lack of harmony and uniformity in approaches between the different agencies, districts and communities. This has been attributed partly on poor funding to the district environment sectors in particular and district local governments in general. The District Forest Officers interviewed for this study indicated that funding for the environment sector is still very poor and this has greatly impacted on the successful sensitization of communities about shea tree conservation. Therefore, while communities are aware of the need for conservation of shea trees, the effectiveness of this conservation measure is rated at 4, i.e. marginally satisfactory.

Community Shea Tree Protection Committees: As a result of community sensitization programmes in the region, Parish Shea Butter Tree Protection Committees have been formed. These are currently helping to enforce and strengthen the sustainable management and use of shea trees at community level. These committees have the full support of the government. However, given that there is still rampant felling of shea trees and little or no planting, there is still a lot of work to do for these committees. While these committees have a strong reason for their existence, the key informants contacts during

the course of this study intimated that although many district development plans are under or due for revision, there is currently no provision for these committees and therefore no budgetary allocations. This greatly compounds the work of these committees. On the basis of the low impact of these committees, their **effectiveness is rated at 3, i.e. Moderately Unsatisfactory.**

Community Policing: On the 21st December 2009, the Cabinet of the Republic of Uganda, under Minute 600 (CT 2000), approved the establishment of the Environmental Protection Force (EPF) in line with the provisions of Section 107 of the National Environment Act, Cap. 153. The establishment of EPF was driven by the need to enforce environmental and conservational laws in a more focused manner. The EPF is currently complementing the efforts of government agencies, such as NEMA, NFA and district local governments in the region to monitor environmental destruction (Figures 9 and 10). The EPF conducts community policing exercise which involve sensitization and warn on the possible dangers and repercussions of destruction of trees (including shea trees). Illegal charcoal trade, which involves massive cutting down of shea trees for conversion to charcoal, has been identified as the biggest threat to the shea trees. NEMA has co-opted EPF in order to ensure effective enforcement as one of the strategies to protect the shea trees. The EPF officers work closely with Uganda Police Force (UPF) territorial commanders in the project area. These include District Police Commanders (DPCs) and Regional Police Commanders (RPCs). The Resident District commissioners (RDCs) serve as coordinators while the District Forestry Officers (DFOs) and District Environment Officers (DEOs) provide technical guidance.

Nonetheless, although community policing as a conservation measure is crucial, its approach has to be done with tender care. Community policing has to be undertaken with a very well formulated communication strategy for visible impacts. Effectiveness of a community sensitization, especially by organs of state which are deemed "coercive", can be greatly affected by lack of a good communication strategy. In this case, there is no documented communication strategy available at the four districts. However, given the "respect" that is usually accorded to Police as an organ of state, and the awareness of their work which was mentioned in all focus group discussions and by key informant interviews, the effectiveness of this conservation measure has been rated at 4, i.e. marginally satisfactory on the basis of ongoing decimation of shea trees despite knowledge of the community policing activities.

Despite this rating, as well as that for community sensitization, it is important to note that change of attitudes takes a long time to be realized. However, with continual sensitization and capacity building this change may gradually be realized. During key informant interviews for this study with the district technical officers, it was pointed out that buy-in of conservation of shea tree resources has been slow in taking root because of few livelihood options. However, it was noted that attitudes are slowly changing for the better.

Prosecution of offenders: The EPF routinely conducts protection patrols to arrest offenders who do not heed to community policing advice. Several operations have been conducted between mid-2014 to September 2015 covering all the districts in the study area. Several suspects were arrested and thousands of bags of charcoal were impounded. Hundreds of charcoal kilns were also destroyed. Some traders were fined according to the provisions of the National Forestry and Tree Planting Act (2003). Some offenders were prosecuted. Similar exercises continue in a routine nature and this has contributed a great deal in curbing/reducing the level of shea tree destruction in the study area.

During the course of study, it was not possible to talk to an individual who had been prosecuted for offences related to shea tree destruction. However, during focus group discussions and key informant interviews, it was pointed out that most people who had been prosecuted tended to avoid destruction of shea trees thereafter. Nevertheless, there are also some individuals who are habitual offenders and readily return to their habits after prosecution and punishment. Given the awe with which communities consider prosecution, **its effectiveness for shea tree conservation can be rated at 5, i.e. satisfactory** because it functions against guilty individuals who can then be given opportunity to reform.

Figure 9. Police checkpoint to control movement of illegally felled shea tree products in Otuke district.

The DPC of Otuke (ASP Awio Darius, third left in the foreground) and Police Officers from Otuke Police Station at a check –point in Ogwete Trading Centre in Olilim Sub-County, Otuke District (Photo: Courtesy of the Environmental Protection Police Unit, Kampala).

Detective ASP Otim David (OC CIID Otuke), ASP Sekanabo Exavius (EPPU) and a police officer from Otuke Police Station in a house-to-house operation to stop the destruction of shea trees (Logs in the foreground were being prepared for conversion to charcoal). (Photo: Courtesy of Environmental Protection Police Unit, Kampala).

Figure 10. Shea tree felled for charcoal burning in Otuke district.

8. SUITABLE USE OPTIONS FOR SHEA TREE RESOURCES

The financial NPV was highest for shea oil production (US$ 8309 ha-1), followed by charcoal production (US$ 5766 ha-1) and lowest for timber production (US$ 4822 ha-1). The NPV of the shea oil use option is by far higher than the other two options because production continues throughout the lifetime of a tree once it achieves maturity. In contrast, charcoal and timber use options were assumed to provide a one-time harvest in 20 years. However, benefit-cost ratio was highest in timber production and lowest in charcoal production (Table 5). The high benefit-cost ratio in timber production is attributable to the use of power saws for felling and converting timber, which reduce the labour requirements (man-days) considerably.

When the external costs and benefits such as climate regulation, biodiversity protection, carbon sequestration and erosion prevention were considered, the profitability gap, NPV (US$ ha-1), between shea oil and the other two options was further increased. This is because these positive externalities were gained under the shea oil use option and lost under the extractive use options of charcoal and timber.

Overall, results indicate that the shea oil use option is financially and economically more profitable than charcoal and timber use options. The shea oil use option is also more environmentally friendly because it maintains the ecosystem services.

Table 5. Profitability of shea use options

	Shea oil	Charcoal	Timber
Financial performance			
NPV	8309	5766	4822
B/C ratio	7.6	3.76	12.5
Economic performance			
NPV	8466	5766	4822
B/C ratio	7.7	3.76	12.5

The results of the sensitivity analysis indicated that the NPVs of the shea use options increased with increasing shea tree density and decreased with increasing discount rates (Figure 11b and c). The superiority of the shea oil use option was robust to changes in shea tree density and discount rates within the range tested. However, sensitivity to shea fruit productivity (Figure 11a) indicated a cross over at about 3 basins of shea fruits per tree. The crossover indicates that if shea fruit productivity falls below 3 basins per tree then the NPV of the shea oil option falls below that of charcoal and timber use options. This implies that efforts should be put in increasing the productivity of shea fruits and shea oil in order to further increase the financial viability of the shea oil use option. This is particularly important given the rising market price of charcoal.

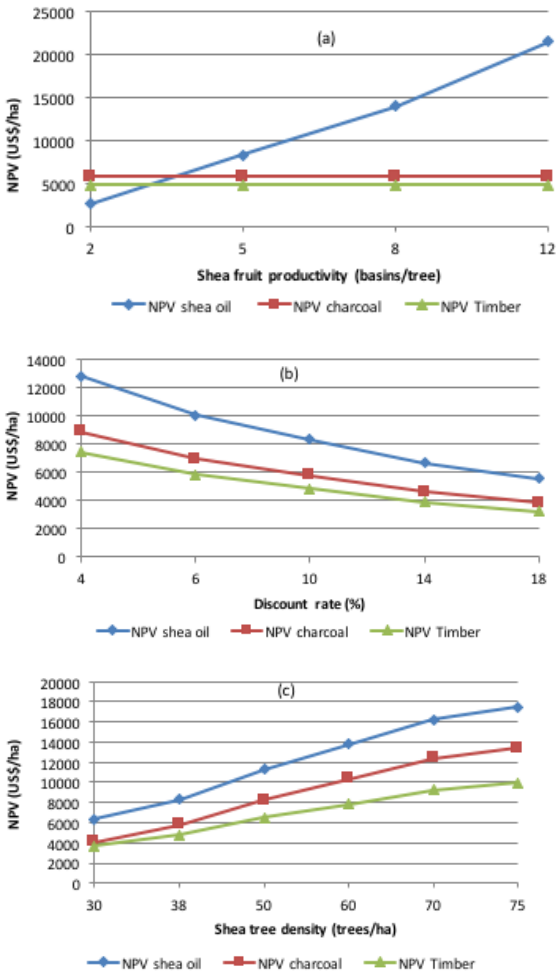

Figure 11. Sensitivity of shea use options' NPV to shea fruit productivity (a), Discount rate (b) and shea tree density (c).

9. CONCLUSION AND RECOMMENDATIONS

9.1 Conclusions

Several traditional practices including pruning, weeding, selective sparing, burning, coppicing, pollarding, manuring, mulching and staking are used in the study area for the management and conservation of shea trees. Pollarding and pruning are subconscious management practices that are intended to achieve alternate objectives e.g. firewood, charcoal and reduce crop shading. The diversity of management practices serves to show the strong connection to shea trees by farmers in their areas.

Shea oil is the most important shea tree product on account of its diversity of uses which range from domestic (cooking) to cultural (traditional marriages, funerals and festivals) and rituals (rain making, celebrating the birth of twins, anointments). The NPV from this study clearly shows that shea oil is the most important use of shea trees. Moreover, use of shea trees for shea oil production ensures the existence of trees which in turn produces additional economic benefits from environmental services.

Although the communities utilize branches of shea trees for firewood, this is considered as a secondary benefit, which would accrue and be available to the communities as long as the shea trees are existing. Therefore, it is a service that the communities may continue to benefit from in both the short and long run, over the lifetime of the trees.

Charcoal which continues to be harvested from shea trees and timber, which is one of the potential products from shea trees, are both destructive uses of shea trees. The results from this CBA have established that as such, their NPV is less than that for shea oil.

9.2 Recommendations

This study indicates that in addition to the environmental benefits that the shea oil use option provides it could provide higher financial returns than converting the shea trees to charcoal or timber. Therefore, the shea oil use option should be promoted. In doing this, the following actions should be taken:

1. Protection and management of shea trees through sensitization, community policing, routine patrols and prosecution of persons that fell shea trees.
2. Promoting the use of traditional practices for the management and conservation of shea trees
3. Promoting the traditional and cultural uses of shea oil as a way of re-establishing the central role of the oil in the cultures of the people in the study area.
4. Promoting market access and value addition of shea oil so that it can be able to reach more lucrative markets and fetch higher value.

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11. ANNEX I: TERMS OF REFERENCE

TERMS OF REFERENCE FOR COST BENEFIT ANALYSES OF THE DIFFERENT USE OPTIONS OF THE SHEA BUTTER TREE RESOURCES IN ABIM, OTUKE, AGAGO AND KITGUM DISTRICTS

GOU/GEF/UNDP PROJECT ON THE CONSERVATION AND SUSTAINABLE USE OF THE THREATENED SAVANNA WOODLAND IN THE KIDEPO CRITICAL LANDSCAPE IN NORTH EASTERN UGANDA

MAY, 2015

1. BRIEF BACKGROUND

Government of Uganda has, through the United Nations Development Programme (UNDP), received 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. The Project is implemented by the National Environment Management Authority (NEMA) on behalf of government in collaboration with Uganda Wildlife Authority (UWA) and relevant partners at the national and district level.

The project aims at strengthening management effectiveness of the Kidepo Critical Landscape (KCL) protected area cluster (comprising of Kidepo Valley National Park, Karenga Community Wildlife Area, Central forest reserves of Morungole, Zulia, Nyangea Napore, Lwala, Timu and Rom) and integrating protected area management in a wider KCL. The project thus focuses on conservation of biodiversity inside and outside protected areas in KCL.

The Goal of the project is to " Conserve the biodiversity and ecosystem values of the Kidepo Critical Landscape to provide sustainable benefit flows at local, national and global levels through enhanced operational capacity and functional landscape planning approaches" with the objective to "Protect the biodiversity of the Kidepo Critical Landscape in North Eastern Uganda from existing and emerging threats". A short term consultant is to undertake a cost benefit analyses of the different use options of the shea butter tree resources in the four pilot districts of Abim, Otuke, Agago and Kitgum.

2. THE ASSIGNMENT

2.1 Purpose

The purpose of the consultancy is to assess the current use options of the shea butter tree and recommend those that enhance sustainable livelihood improvement and environmental quality.

2.2 Scope

The consultant is expected to conduct an assessment of the current use options of the shea butter tree in the districts of Abim, Otuke, Agago and Kitgum. In consultation with NEMA and the district technical staff, the consultant will carry out the following;

i) Review and provide information on the ecology and distribution of shea butter trees in the districts of Abim, Otuke, Agago and Kitgum
ii) Assess the different uses of shea tree resources and their implications on the shea tree resource;
iii) Assess the social and economic cost of the different use options in bullet two above;
iv) Document the traditional practices including role of women and men on the use and conservation of the shea tree resources;

v) Assess the effectiveness of measures in place for the protection and sustainable use of shea butter trees at the national, district and local community level;
vi) Basing on (i) to (v) propose the most suitable use option for the shea that has least social and environmental cost but with better environmental and livelihoods benefits

2.3 Approach and methodology

The assignment will involve field work and desk study complemented by extensive stakeholder consultations. Also, the Consultant will be expected to present the report at a validation workshop organized by NEMA for validating the findings and building stakeholder consensus.

The Terms of Reference (TOR) will be discussed with the successful consultant prior to signing of the contract. During the assignment, the consultant is expected to update the Project Manager through regular meetings (preferably every 14 days) on progress and implementation of the agreed tasks.

2.4 Desired skills and competence

a) Relevant academic background (post graduate qualification as minimum) in forestry, biodiversity, sustainable and socio-economic development, and or environmental management.
b) Proven experience of at least 3 years in undertaking cost benefit analysis in conservation programmes and projects.
c) The consultant should be able to access both private and public documentation on cost benefit analysis, engage stakeholders and be able to produce excellent written reports in such a manner that also non-expert audiences can easily understand the information gathered.
d) Solid analytical and conceptual skills, ability to think creatively and meet deadlines.
e) Good knowledge of local context (culture, political environment, and geography) of the project districts is an added advantage.
f) An eye for detail with ability and sense to synthesize large data and paint a coherent overall picture.

2.5 Deliverables

The consultant is expected to prepare reports as well as facilitate a validation workshop as outlined below;
a) Submit an inception report five days after signing the contract detailing how the assignment will be undertake
b) Prepare a draft report (50 pages max) consisting of findings of the shea butter cost benefit analysis and recommendations for the most appropriate and critical use options not later than eight weeks after signing the contract.
c) Present the draft report at validation workshop. organized by NEMA. During this workshop, a power point presentation of the methods used, areas covered, key findings and associated recommendations should be made.
d) Submit a final report which has stakeholders' comments incorporated (before end of the 3rd week from the date of signing the contract).

2.6 Duration of the assignment

The assignment is expected to be completed within two (02) months after signing of the contract.

2.7 Budget

The estimated total cost of this assignment covers both professional fees as well as any other costs to be incurred by the consultant excluding transport to and from the field.

3. SUBMISSION PROCEDURE

Consultants who wish to express their interest in undertaking the prescribed assignment are requested to send hard-copies of the following:

i) A technical proposal **not exceeding 15 pages** (in a sealed envelope clearly marked "Technical Proposal") containing:

a) An understanding and interpretation of the TORs.
b) Methodology to be used in undertaking the assignment.
c) Time and activity schedule.
d) Evidence of relevant experience and samples of products related to the assignment.
e) Curriculum vitae of the lead consultant to undertake the assignment plus short CVs of the rest of the team.

ii) A financial proposal not **exceeding 2 pages** (sealed in a separate envelope clearly marked "Financial Proposal") including:

- Consultant's daily rates in Uganda Shillings.
- Any other related costs (excluding the costs of the stakeholder validation workshop and transport to and from the field).

The two envelopes will then be sealed in a third one clearly marked: **"Proposal for cost benefit analysis for shea butter tree use options in the districts of Abim, Agago, Kitgum and Otuke"** and sent to;

The Executive Director,
National Environment Management Authority,
P.O Box 22255, Kampala
Attn: Project Manager,
Kidepo Critical Landscape project.

By 15th April 2015.

4. REPORTING

The Consultant(s) shall report to the Executive Director NEMA but will work closely with the Project Manager and the Project Coordinator.

12. ANNEX II: KEY INFORMANTS AND PARTICIPANTS OF FOCUS GROUP DISCUSSIONS

a) Key Informants

Name	District	Sub-County	Contacts
1. Mr. Olal David (DNRO)	Agago	Town Council	0782 453184
2. Mr. Odongo Lira (Rwot II)	Agago	Lapilyet Munutek West	0777 011614
3. Mr. Okot George DFO	Otuke	Town Council	-
4. Ms. Apio Hellen	Otuke	Town Council	-
5. Ms. Apio Semi	Otuke	Town Council	-
6. Mr. Opio Anthony Okello	Abim	Town Council	-
7. Mr. Ogwal Johnny (ACCORD)	Abim	Town Council	-
8. Ms. Angee Margaret	Kitgum	Lamida-Labongo Okidi	-
9. Mr. Opina Patrick	Kitgum	Lamida-Labongo Okidi	-

a) FGD Participants

FGD I

Name	District	Sub-County	Contacts
1. Ms. Asiko Grace	Agago	Wol	0774 898643
2. Ms. Aketch Fatuma	Agago	Wol	0788 550163
3. Ms. Amuge Sarah	Agago	Wol	0786 037316
4. Mr. Ojok Charles	Agago	Wol	0778 173755
5. Mr. Ojara Richard	Agago	Wol	0778 650101

FGD II

Name	District	Sub-County	Contacts
1. Mr. Oryem Augustine	Agago	Pabongo	0782 552253
2. Ms. Aciro Gladys	Agago	Pabongo	-
3. Ms. Ajwang Heromina	Agago	Pabongo	-
4. Ms. Amoo Gilinimina	Agago	Pabongo	0777 369652
5. Ms. Angom Betty	Agago	Pabongo	0782 713866
6. Mr. Otika Bob	Agago	Pabongo	0782 557700

FGD III

Name	District	Sub-County	Contacts
1. Ms. Namulinda Winika	Agago	Lira-Palwo	0778 058493
2. Mr. Odongo Mathew	Agago	Lira-Palwo	0778 058493
3. Ms. Adyero Christine	Agago	Lira-Palwo	-
4. Ms. Amono Pasca	Agago	Lira-Palwo	0774 211468

FGD IV

Name	District	Sub-County	Contacts
1. Ms. Okello Judith	Otuke	Adwari	-
2. Mr. Onyai Nelson	Otuke	Adwari	-
3. Mr. Apula Denis	Otuke	Okwang	-
4. Mr. Ocen Moses	Otuke	Okwang	-
5. Ms. Ekemo Emma S	Otuke	Okwang	-
6. Ms. Awor Ketty	Otuke	Adwari	-
7. Mr. Okwir Alex	Otuke	Adwari	-
8. Ms. Susan	Otuke	Orum	-
9. Ms. Apio Mary	Otuke	Orum	-

FGD V

Name	District	Sub-County	Contacts
1. Ms. Awio Jacinta	Otuke	Ogor	-
2. Ms. Akuku Jesca	Otuke	Ogor	-
3. Ms. Omoe Janat	Otuke	Ogor	-
4. Mr. Acunyu Collin	Otuke	Ogor	-
5. Ms. Apolo Rose	Otuke	Ogor	-

FGD VI

Name	District	Sub-County	Contacts
1. Ms. Awo Jenipher	Abim	Lotukei	-
2. Mr. Ocero Timothy	Abim	Lotukei	-
3. Ms. Akello Sharon	Abim	Lotukei	-
4. Ms. Ayoo Jenipher	Abim	Lotukei	-
5. Ms. Auma Rose	Abim	Lotukei	-
6. Ms Awili Jocy	Abim	Lotukei	-

FGD VII

Name	District	Sub-County	Contacts
1. Ms. Akullu Christine	Abim	Kalkala	-
2. Mr. Logira Sam	Abim	Kalkala	-
3. Mr. Owili Martins	Abim	Abim	-
4. Mr. Ojok Collin	Abim	Aminata	-
5. Ms. Akullu Consy	Abim	Kanu	-
6. Mr. Obalim Benson	Abim	Kanu	-
7. Mr. Onencan James	Abim	Kanu	-
8. Mr. Omara Tom	Abim	Kanu	-
9. Mr. Otim Peter	Abim	Kalkala	-

FGD VIII

Name	District	Sub-County	Contacts
1. Ms. Agerorwot Jacky	Kitgum	Labongo-Amida	-
2. Ms. Anek Nancy	Kitgum	Labongo-Amida	-
3. Ms. Lakot Lucy	Kitgum	Labongo-Amida	-
4. Mr. Onekalit Ivan	Kitgum	Labongo-Amida	-
5. Ms. Ayuku Jackline	Kitgum	Labongo-Amida	-
6. Ms. Acaru Roseline	Kitgum	Labongo-Amida	-
7. Ms. Aweko Christine	Kitgum	Labongo-Amida	-
8. Ms. Apio Grace	Kitgum	Labongo-Amida	-
9. Ms. Apwongo Margaret	Kitgum	Labongo-Amida	-
10. Ms. Anek Girimina	Kitgum	Labongo-Amida	-
11. Ms. Onguti Santa	Kitgum	Labongo-Amida	-
12. Ms. Lado Rose	Kitgum	Labongo-Amida	-
13. Ms. Acen Joice	Kitgum	Labongo-Amida	-
14. Ms. Ajwayo Grace	Kitgum	Labongo-Amida	-
15. Ms. Awol Alice	Kitgum	Labongo-Amida	-

FGD IX

Name	District	Sub-County	Contacts
1. Ms. Akwero Jacinta	Kitgum	Orom	-
2. Ms. Arach Monica	Kitgum	Orom	-
3. Ms. Apio Phylis	Kitgum	Mucwini	-
4. Ms. Akumu Jacinta	Kitgum	Mucwini	-
5. Ms. Aremo Norah	Kitgum	Lagoro	-
6. Ms. Anek Hellen	Kitgum	Lagoro	-
7. Ms. Anena Lydia	Kitgum	Namukora	-
8. Ms. Lakot Daisy	Kitgum	Namukora	-

Republic of Uganda